



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Jeffrey A. Newcomer, Editors

Volume 15

BOREAS AFM-07 SRC Surface Meteorological Data

H. Osborne, K. Young, V. Wittrock, and S. Shewchuck

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

The NASA STI Program Office ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.
- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results . . . even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at <http://www.sti.nasa.gov/STI-homepage.html>
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA Access Help Desk at (301) 621-0134
- Telephone the NASA Access Help Desk at (301) 621-0390
- Write to:
NASA Access Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320

NASA/TM—2000–209891, Vol. 15



Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Jeffrey A. Newcomer, Editors

Volume 15

BOREAS AFM-07 SRC Surface Meteorological Data

*Heather Osborne, Kim Young, Virginia Wittrock, and Stan Shewchuck
Saskatchewan Research Council*

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

June 2000

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
Price Code: A17

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Price Code: A10

BOREAS AFM-7 SRC Surface Meteorological and Radiation Data

Heather Osborne, Kim Young, Virginia Wittrock, Stan Shewchuck

Summary

The Saskatchewan Research Council (SRC) collected surface meteorological and radiation data from December 1993 until December 1996. The data set comprises Suite A (meteorological and energy balance measurements) and Suite B (diffuse solar and longwave measurements) components. Suite A measurements were taken at each of 10 sites, and Suite B measurements were made at 5 of the Suite A sites. The data cover an approximate area of 500 km (North-South) by 1,000 km (East-West) (a large portion of northern Manitoba and northern Saskatchewan). The measurement network was designed to provide researchers with a sufficient record of near-surface meteorological and radiation measurements. The data are provided in tabular ASCII files, and were collected by AFM-7.

Table of Contents

- 1) Data Set Overview
- 2) Investigator(s)
- 3) Theory of Measurements
- 4) Equipment
- 5) Data Acquisition Methods
- 6) Observations
- 7) Data Description
- 8) Data Organization
- 9) Data Manipulations
- 10) Errors
- 11) Notes
- 12) Application of the Data Set
- 13) Future Modifications and Plans
- 14) Software
- 15) Data Access
- 16) Output Products and Availability
- 17) References
- 18) Glossary of Terms
- 19) List of Acronyms
- 20) Document Information

1. Data Set Overview

1.1 Data Set Identification

BOREAS AFM-07 SRC Surface Meteorological and Radiation Data

1.2 Data Set Introduction

BOReal Ecosystem-Atmosphere Study (BOREAS) personnel at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) and the Canada Centre for Remote Sensing (CCRS) established a contract with the Saskatchewan Research Council (SRC) to implement and maintain a network of automatic meteorological stations (AMS) to measure surface meteorological and radiation parameters during BOREAS activities in Saskatchewan and Manitoba, Canada. SRC personnel installed and monitored the equipment, collected and quality checked the data, and delivered the data to the BOREAS Information System (BORIS) on a regular basis from 1994 through early 1997. The SRC AMS network comprises 10 Suite A and 5 Suite B sites.

1.3 Objective/Purpose

The SRC AMS data were collected to:

- Measure the microclimatic variability across the BOREAS sites.
- Provide input data for numerical simulation models.
- Collect broad-band reflected and emitted radiation to help with evaluating and calibrating satellite and aircraft imagery.

1.4 Summary of Parameters

The parameters measured at Suite A sites included date and time, within- and above-canopy temperature, atmospheric pressure, relative humidity, wind speed and direction, precipitation, snow depth, soil temperature profiles, shortwave radiation, photosynthetically active radiation (PAR), and net radiation. The parameters measured at Suite B sites included date and time, and shortwave and longwave radiation.

1.5 Discussion

The SRC AMS stations cover an area of roughly 500 km (North-South) by 1,000 km (East-West) (a large portion of northern Manitoba and northern Saskatchewan). The 10 Suite A stations were installed within the BOREAS study region (see Figure 1) prior to the first Intensive Field Campaign (IFC) that occurred in May 1994. All Suite A stations were equipped to measure basic meteorological and radiation parameters. The Suite A radiation sensors measured shortwave and net radiation, PAR, and longwave radiation. The measurement height for all the above-canopy measurements was approximately two to six meters above the canopy top. The below-canopy measurements were made at approximately 2 meters from the forest floor. The infrared radiation sensor is pointed at an angle of 45 degrees to measure canopy top temperature of the forest at each individual site. The infrared sensor is located at all the sites except Saskatoon and Meadow Lake. Precipitation at each site is measured with a Belfort weighing precipitation gauge that is mounted with an alter shield. Rainfall intensity is measured with a tipping bucket rain gauge at each site.

Five of the Suite A sites were augmented with additional radiation sensors to form a Suite B classification. Suite B sensors consist of a diffuse shortwave radiation sensor and a pyrgeometer. Figure 2 illustrates a typical boreal forest instrumentation array.

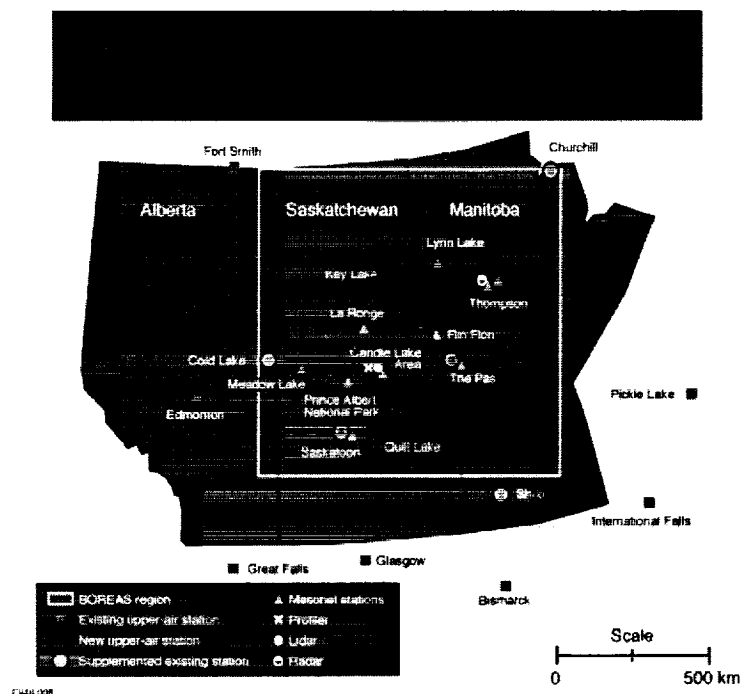
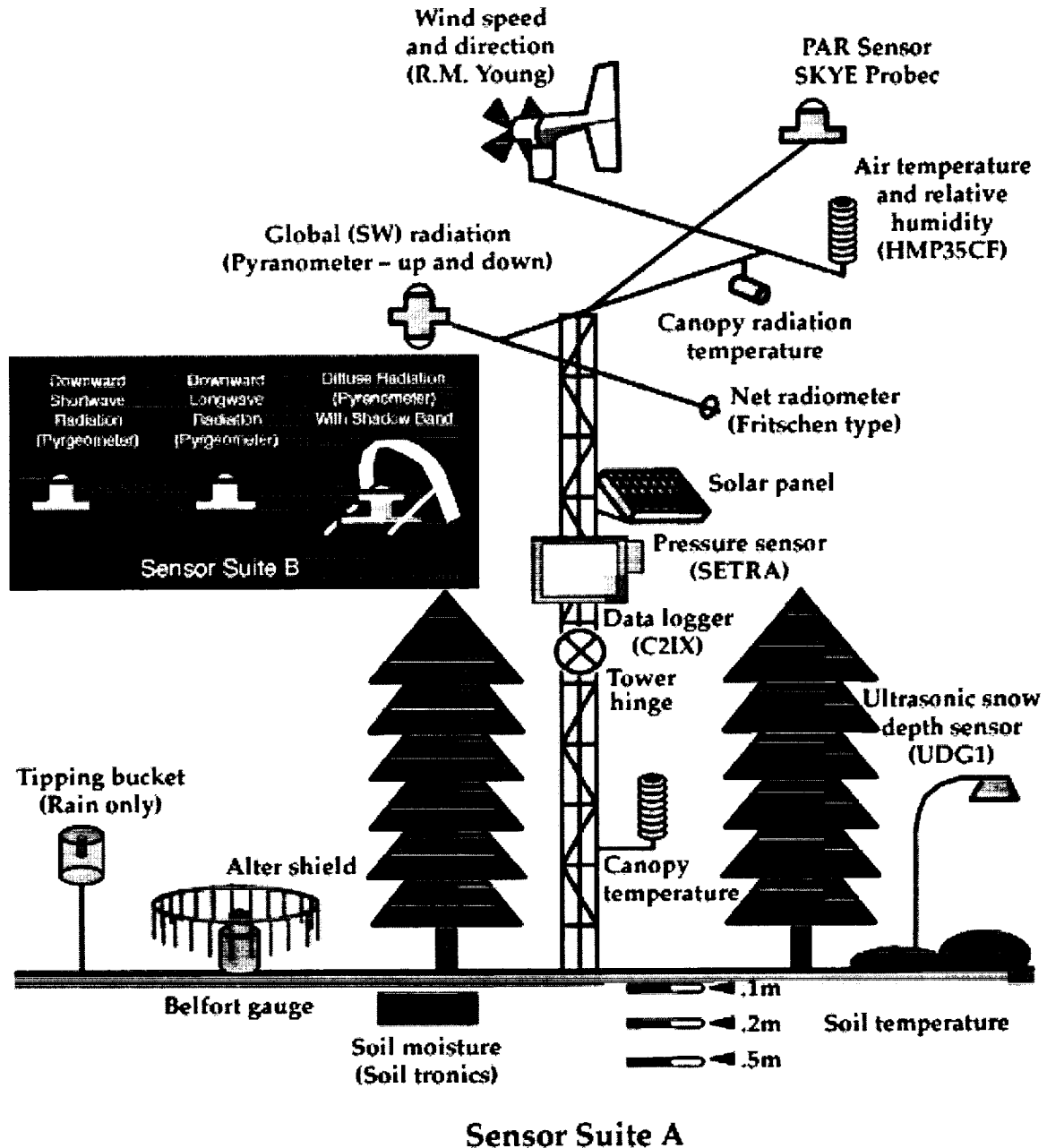


Figure 1: BOREAS Meteorological Network

BOREAS SURFACE METEOROLOGICAL INSTRUMENTATION ARRAY



J737.001

Figure 2: BOREAS Surface Met Array

1.6 Related Data Sets

BOREAS AES Campbell Scientific Surface Meteorological Data
 BOREAS AES MARSII Surface Meteorological Data
 BOREAS AES READAC Surface Meteorological Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Dr. Stanley R. Shewchuk
Lead Scientist
Atmospheric Sciences Section
Environment Technology Division
Saskatchewan Research Council

2.2 Title of Investigation

Atmospheric Sciences Infrastructure Core Measurements for BOREAS (AFM-07)

2.3 Contact Information

Contact 1:

Heather Osborne/Kim Young
Instrumentation and Automation Section
Saskatchewan Research Council
11 Innovation Blvd.
Saskatoon, Saskatchewan
Canada S7N 2X8
(306) 933-6759
osborne@src.sk.ca
young@src.sk.ca

Contact 2:

Virginia Wittrock
Research Scientist
Climatology Section
Saskatchewan Research Council
11 Innovation Blvd.
Saskatoon, Saskatchewan
Canada S7N 2X8
(306) 933-8122
wittrock@src.sk.ca

Contact 3:

Jeffrey A. Newcomer
Raytheon ITSS
Code 923
NASA GSFC
Greenbelt, MD 20771
(301) 286-7858
Jeffrey.Newcomer@gsfc.nasa.gov

3. Theory of Measurements

The theory behind the meteorological measurements is to understand the general climate of the Canadian boreal region. The main purpose of each AMS station is to gather enough precipitation, temperature, and other meteorological information to fully understand the climate of the boreal forest. Data from all of the instruments were stored on a data logger, which performed some of the initial data processing.

4. Equipment

4.1 Sensor/Instrument Description

This section is a comprehensive description of each AMS site. The parameters included are: site name, location and elevation, and a list of each instrument at the site. There is a detailed description of each instrument in the first site that contains the instrument. Within each detailed instrument description there is an explanation of what the instrument is used for; heights of each instrument; its supplier and/or manufacturer; and serial number. Additionally, the description of radiation sensors will contain the wavelengths they are able to measure. At subsequent sites containing the same instrument a shorter description is given, containing only the serial number and location details specific to that site.

The sites were inspected by human observers. Suite B sites were visited every 3 days. Suite A sites were visited every 7 to 10 days in the summer and every 3 to 5 days in the winter to check for frost build up on the instruments.

4.1.1 Collection Environment

The collection environment for the SRC AMS stations varied greatly from season to season and site to site. All instruments, except where otherwise noted, were exposed to the elements at all times. The sites were all located in relatively undisturbed locations and the instruments were checked regularly.

During winter, the instruments were exposed to frequent snow storms and temperatures that reached -40 °C. During the summer months, temperatures at the sites reached 30 °C. No covers were built to protect the instrumentation from precipitation, wind, animal damage, or vandalism.

4.1.2 Source/Platform

Suite A sites use a triangular cross-section Rohn tower as a platform for mounting the majority of the Suite A instruments. Each side of the tower is roughly 0.5 meters across and is internally supported by solid steel "zigzag" cross braces. The tower is designed with a hinge roughly halfway along its length that allows the tower to be folded down so that instruments may be attached and serviced without climbing gear. When the installation is complete, the tower can be extended to its full height. The only sites that do not use a Rohn tower are Meadow Lake and Saskatoon, where no forest exists and a tall tower is not required. Components mounted on the tower include the data logger, pressure sensor, solar panel, albedometer, net radiometer, air temperature and relative humidity sensors, PAR sensor, and wind speed and direction sensor. A lightning rod is also attached to the top of each tower.

The precipitation gauges at each site are mounted on a separate wooden platform located a short distance from the Rohn tower. The distance varies by site. The platform is 3 meters high, 0.9 meters wide, and 2.4 meters long. These platforms are located at all AMS sites except Meadow Lake and Saskatoon.

The Suite B sites are usually located a fair distance away from the Rohn tower that holds the Suite A instrumentation (Meadow Lake and Saskatoon being the exceptions). The Suite B sites recorded information on a separate data logger (usually a CR10).

4.1.3 Source/Platform Mission Objectives

The objective of the Rohn tower is to provide a stable place to hang instrumentation for the duration of the experiment. Additionally, the tower provides a method of placing instruments at various levels within the canopy.

Suite A Instruments

| <u>Instrument Type</u> | <u>Measured Parameters</u> |
|---|------------------------------|
| PAR radiometer | PAR radiation |
| Net radiometer | Net radiation |
| Albedometer | Incoming solar radiation |
| | Reflected solar radiation |
| Temperature and relative humidity probe | Upper canopy air temperature |
| | Relative humidity |
| Temperature probe | Lower canopy air temperature |
| Soil temperature probe | Soil temperature |
| Barometric pressure | Air pressure |
| IR temperature | Surface IR temperature |
| Wind monitor | Wind direction |
| | Wind speed |
| Belfort rainfall transmitter | Precipitation |
| Ultrasonic depth gauge | Snow depth |
| Soil moisture sensor | Soil moisture |
| Tipping bucket rain gauge | Precipitation |

Suite B Instruments

| <u>Instrument Type</u> | <u>Measured Parameters</u> |
|------------------------------|-----------------------------|
| Pyrgeometer | Incoming longwave radiation |
| | Outgoing longwave radiation |
| Pyranometer with shadow band | Diffuse solar radiation |

4.1.5 Principles of Operation

Suite A Instruments

| <u>Instrument</u> | <u>Principle of Operation</u> |
|---------------------------------|--|
| Data Logger | This instrument is used to store and partially manipulate the data. |
| Multiplexer | The Multiplexer is used to increase the number of sensors that may be scanned by Campbell Scientific (CS) data loggers. |
| Spark Gapped Junction Box | The Junction Box is designed to minimize damage to instruments connected to wires on which a high voltage could be induced through electrostatic discharge due to lightening. There are two per tower. |
| Modem | The DC112 Modem is a 300/1200 baud modem employing the "AT" command set. It is used as a remote site modem connected to a CS data logger. |
| Solar Panels | The Model MSX-30 Solarex Solar Panel photovoltaic module is designed to operate DC loads with small to moderate energy requirements. |
| PAR Radiometer | The Skye Single Channel PAR Sensor is used to measure PAR Radiation. These sensors have cosine-corrected heads, each containing a semiconductor diode and filter system responding to light. |
| Net Radiometer | The Fritschen Q-6 Net Radiometer is a high output instrument that is designed to measure net radiation. Net radiation is defined as the sum of all incoming radiation minus the outgoing radiation. Incoming radiation consists of direct and diffuse shortwave radiation and longwave sky radiation. Outgoing radiation consists of reflected and terrestrial longwave radiation. |
| Albedometer (Solar & Reflected) | None given |

| | |
|--|--|
| Temperature and Relative Humidity Probe (Above Canopy) | None given |
| Temperature Probe (Lower Canopy) | None given |
| Soil Temperature Probe | None given |
| Barometric Pressure sensor | None given |
| IR Thermometer | The Everest Interscience Model 4000AL Infrared Thermometer measures the IR radiation emitted by objects and outputs the temperature, or a signal that is related to the temperature, of the object. The major advantage of this IR sensor is that no physical contact is made with the object being measured. |
| Wind Direction/Wind Speed sensor | None given |
| Belfort Precipitation Gauge | None given |
| Snow Depth Sensor | None given |
| Soil Moisture Sensor | The Matrix Water Potential Soil Moisture Sensor measures soil moisture by measuring the heat differential between a warmed temperature probe and an unwarmed probe. The theory is that when a probe is heated the temperature rise will be a function of the water content of the medium (the soil). By inserting a heater and a temperature sensor in a fixed porous block in contact with soil, the temperature rise of the heater can be correlated to the water potential of the soil. |
| Tipping Bucket Precipitation Gauge | None given |

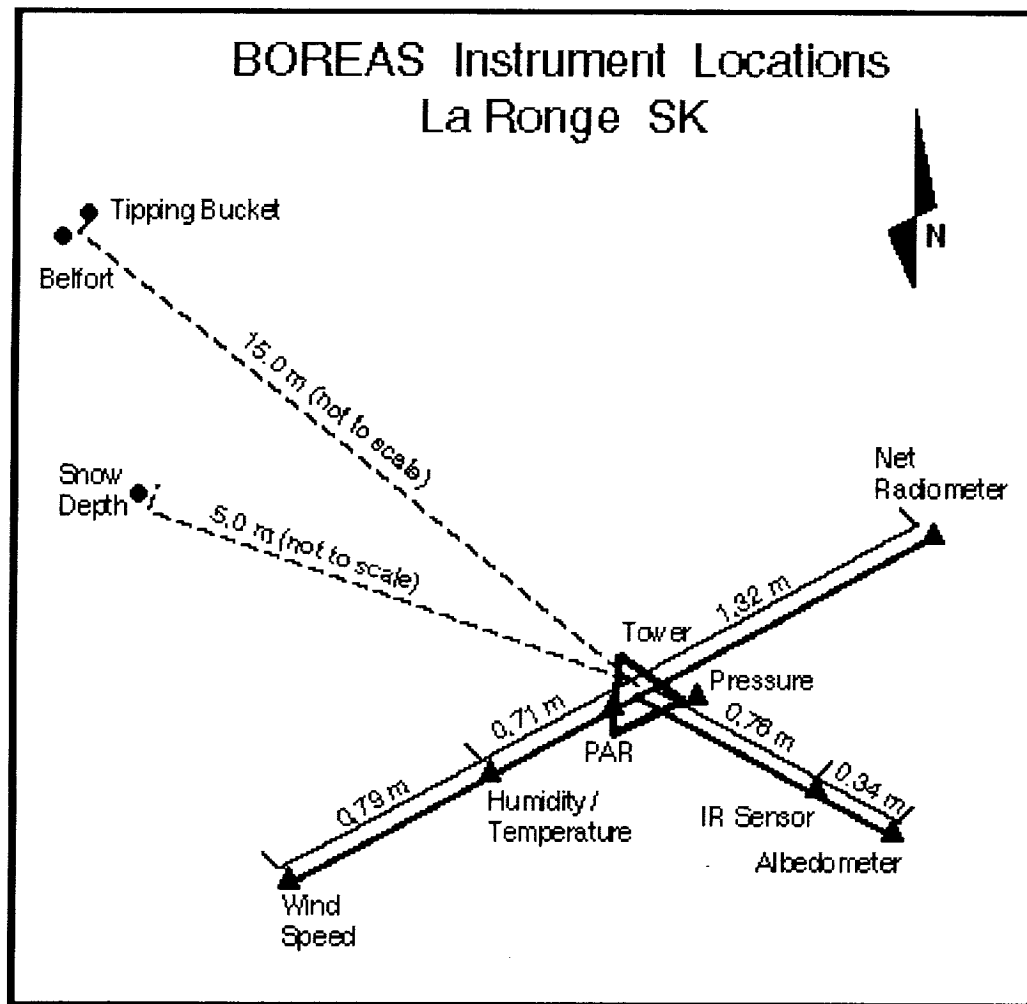
Suite B Instruments

| <u>Instrument</u> | <u>Principle of Operation</u> |
|-------------------|--|
| Data Logger | This instrument is used to store and partially manipulate the data. |
| Pyrgeometer | This instrument measures the exchange of radiation between a horizontal blackened surface and the target viewed. For the measurement of longwave radiation in general, and for the isolation of this from the solar shortwave radiation in daytime, a 30mm diameter hemisphere of silicon is used. This instrument is measuring downward longwave radiation from the atmosphere only. |
| Pyranometer | None given |
| Shadow Band Stand | The shadow band attaches to the suite B pyranometer that measures incoming solar radiation. The shadow band is intended to block out the direct rays of the sun and force the pyranometer to measure only the diffuse component of solar radiation. The band is wide enough to block the sun's direct rays for a few weeks at a time. A local observer adjusted the shadow band monthly. |

4.1.6 Sensor/Instrument Measurement Geometry

The following figures illustrate the location of each instrument in relation to the other instruments at the data collection sites. Unless otherwise noted, all instrument are on the Suite A tower present at each site. The Meadow Lake and Saskatoon sites are the only sites that do not have towers. At those sites, no relative location information is available. A negative height indicates that the instrument is located below ground surface.

La Ronge, SK



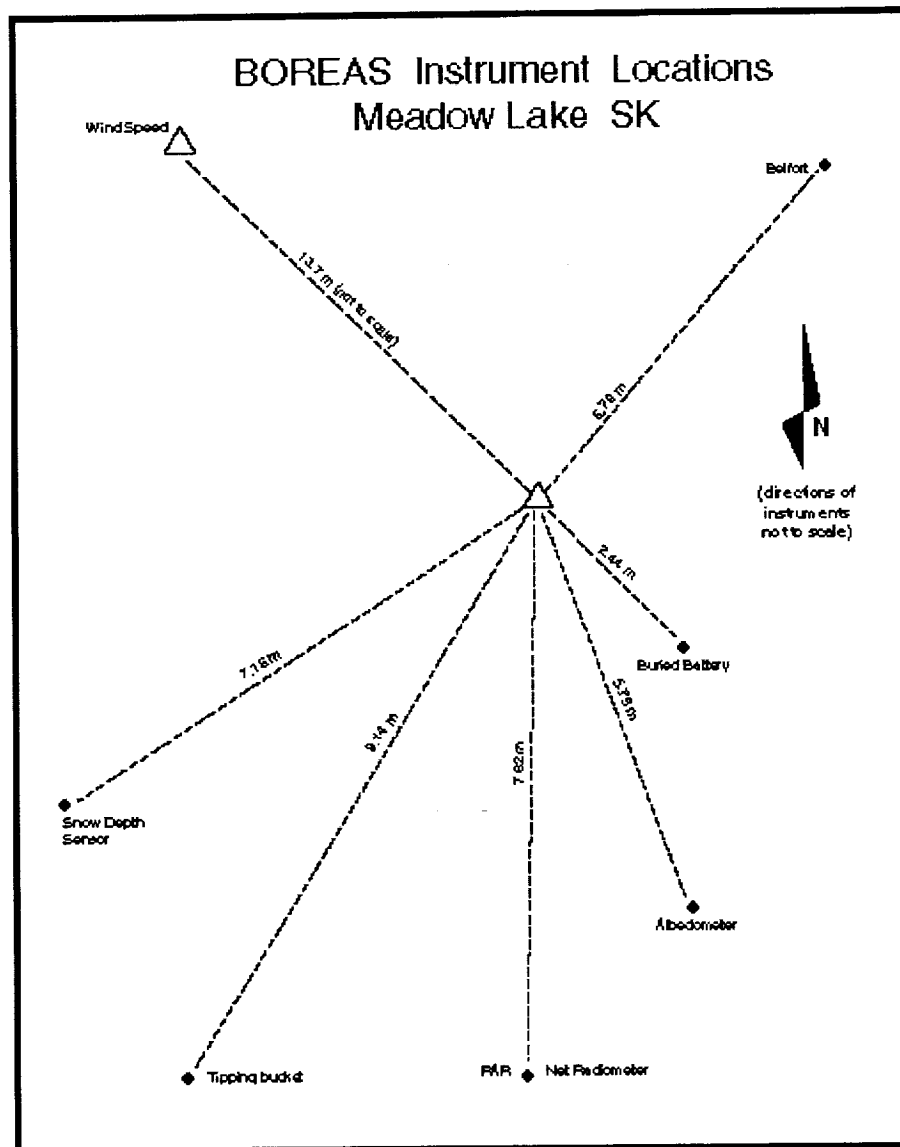
Suite A Instrument

PAR radiometer
 Net radiometer
 Albedometer
 Temperature/relative humidity probe
 Lower canopy temperature probe
 Soil temperature probe
 Soil temperature probe
 Soil temperature probe
 Barometric pressure
 IR temperature
 Wind monitor
 Belfort precipitation gauge
 Snow depth gauge
 Soil moisture sensor
 Tipping bucket precipitation

Height on tower/Location

16.15 m
 16.15 m
 16.15 m
 16.15 m
 1.83 m
 -10 cm, 1.5 m north of tower
 -20 cm, 1.5 m north of tower
 -50 cm, 1.5 m north of tower
 16.15 m
 16.15 m
 16.15 m
 15.0 m north-northwest of tower
 1730 cm, 5 m northwest of tower
 -10 cm, location not available
 15.0 m north-northwest of tower

Meadow Lake, SK

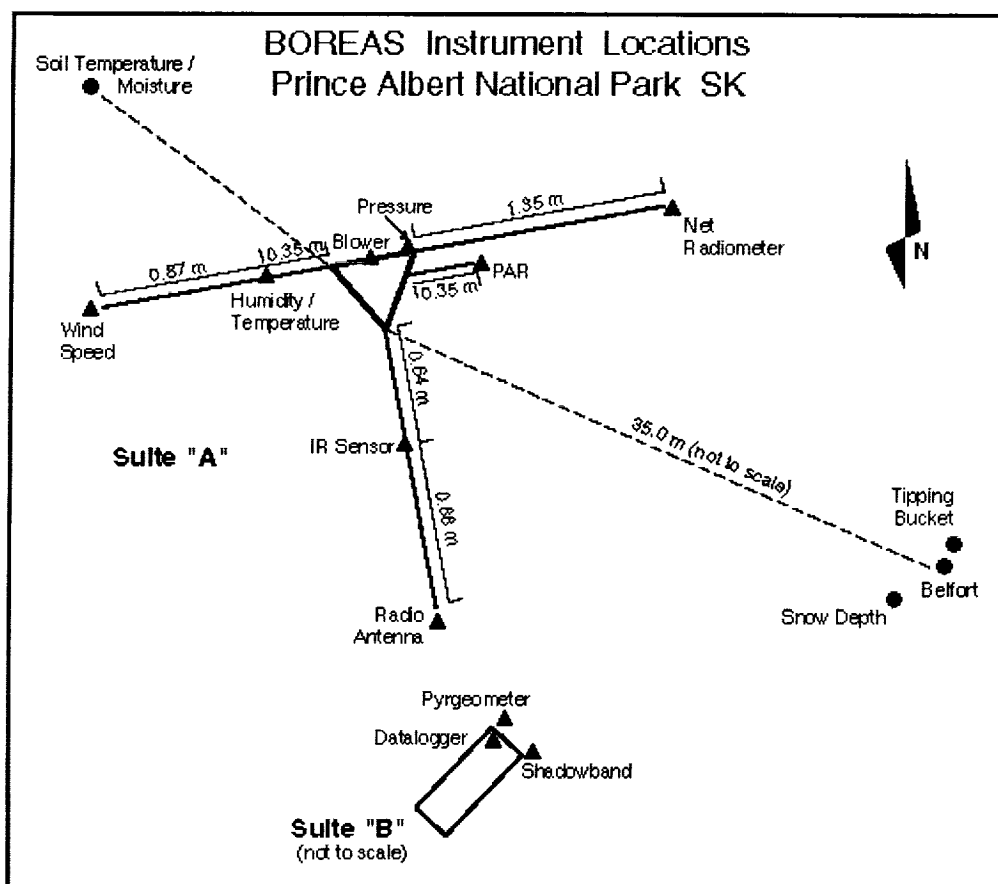


Suite A Instrument

Height on tower/Location

| | |
|-------------------------------------|---------------|
| PAR radiometer | 2.1 m |
| Net radiometer | 2.0 m |
| Albedometer | 1.9 m |
| Temperature/relative humidity probe | 2.59 m |
| Soil temperature probe | -10 cm |
| Soil temperature probe | -20 cm |
| Soil temperature probe | -50 cm |
| Barometric pressure | 2.03 m |
| Wind monitor | 9.75 m |
| Belfort precipitation gauge | Not available |
| Snow depth gauge | 1570 cm |
| Soil moisture sensor | -10 cm |
| Tipping bucket precipitation | Not available |

BOREAS SSA-OA



Suite A Instrument

| | |
|-------------------------------------|----------------------------------|
| PAR radiometer | 23.71 m |
| Net radiometer | 23.71 m |
| Albedometer | 23.71 m |
| Temperature/relative humidity probe | 23.71 m |
| Lower canopy temperature probe | 4 m |
| Soil temperature probe | -10 cm, 1.5 m northwest of tower |
| Soil temperature probe | -20 cm, 1.5 m northwest of tower |
| Soil temperature probe | -50 cm, 1.5 m northwest of tower |
| Barometric pressure | 21.87 m |
| IR temperature | 23.71 m |
| Wind monitor | 23.71 m |
| Belfort precipitation gauge | 35.0 m north-northwest of tower |
| Snow depth gauge | 1500 cm, 35 m southeast of tower |
| Soil moisture sensor | -10 cm, 1.5 m northwest of tower |
| Tipping bucket precipitation | 35.0 m southeast of tower |

Height on tower/Location

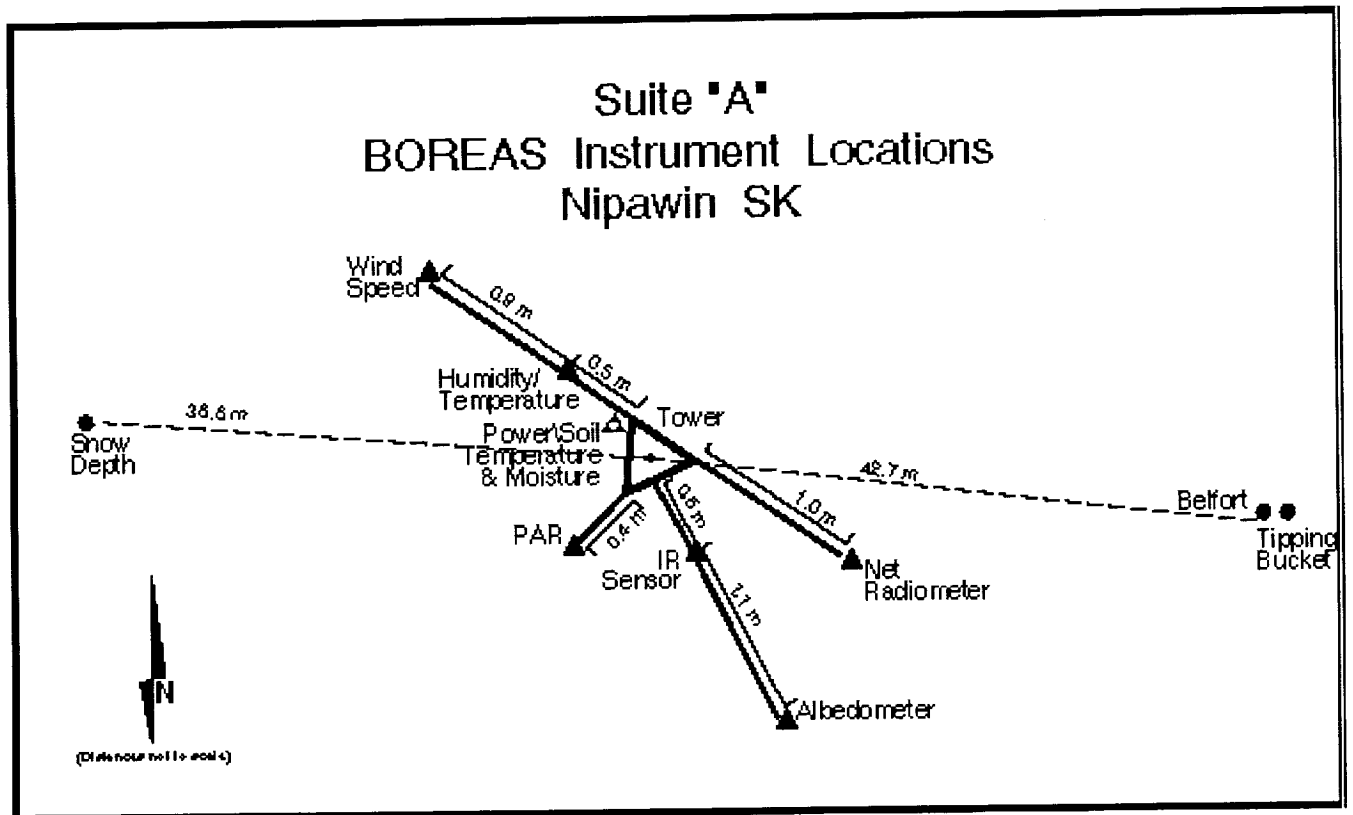
Suite B Instrument

(located on the main flux tower)

| | |
|-------------------|---------|
| Pyrgeometer | 36.83 m |
| Pyranometer | 36.68 m |
| Shadow Band Stand | 36.68 m |

Height on tower/Location

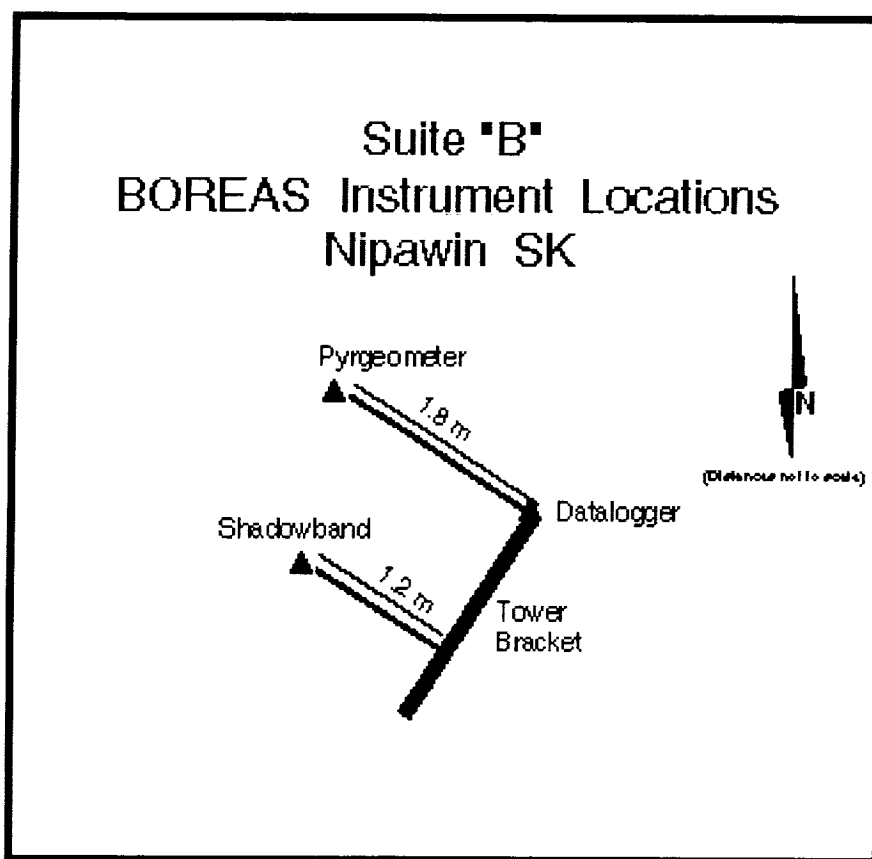
BOREAS SSA-OJP (Suite A)



Suite A Instrument

| <u>Suite A Instrument</u> | <u>Height on tower/Location</u> |
|-------------------------------------|---------------------------------------|
| PAR radiometer | 20.7 m |
| Net radiometer | 20.7 m |
| Albedometer | 20.7 m |
| Temperature/relative humidity probe | 20.7 m |
| Lower canopy temperature probe | 5.5 m |
| Soil temperature probe | -10 cm, northwest of tower |
| Soil temperature probe | -20 cm, northwest of tower |
| Soil temperature probe | -50 cm, northwest of tower |
| Barometric pressure | Not available, Not available |
| IR temperature | 20.7 m |
| Wind monitor | 20.7 m |
| Belfort precipitation gauge | 42.7 m east-southeast of tower |
| Snow depth gauge | 1510 cm, 37 m west-northwest of tower |
| Soil moisture sensor | -10 cm, northwest of tower |
| Tipping bucket precipitation | 42.7 m east-southeast of tower |

BOREAS SSA-OJP (Suite B)



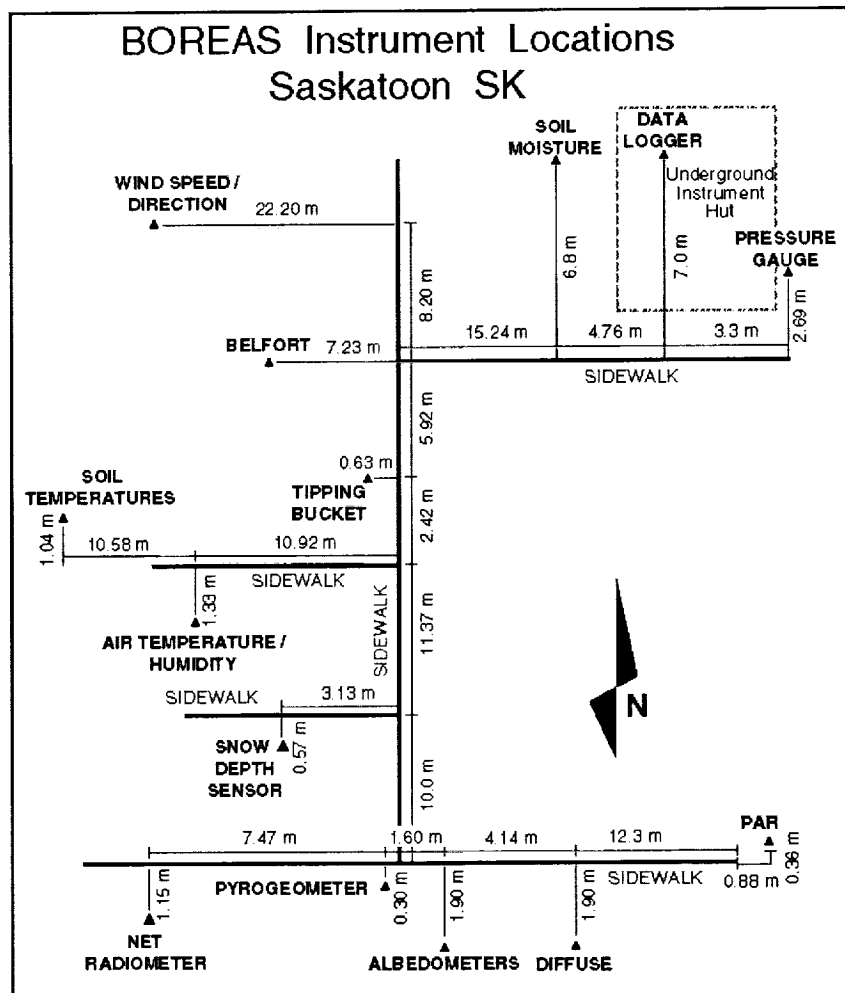
Suite B Instrument

(located on the main flux tower)

Height on tower/Location

| | |
|-------------------|--------|
| Pyrgometer | 35.1 m |
| Pyranometer | 36.6 m |
| Shadow Band Stand | 36.6 m |

Saskatoon, SK



Suite A Instrument

| | |
|-------------------------------------|---------------|
| PAR radiometer | 1.3 m |
| Net radiometer | 1.45 m |
| Albedometer | 1.62 m |
| Temperature/relative humidity probe | 1.71 m |
| Soil temperature probe | -10 cm |
| Soil temperature probe | -20 cm |
| Soil temperature probe | -50 cm |
| Barometric pressure | 1.3 m |
| Wind monitor | 10 m |
| Belfort precipitation gauge | 1.2 m |
| Snow depth gauge | 1235 cm |
| Soil moisture sensor | -10 cm |
| Tipping bucket precipitation | Not available |

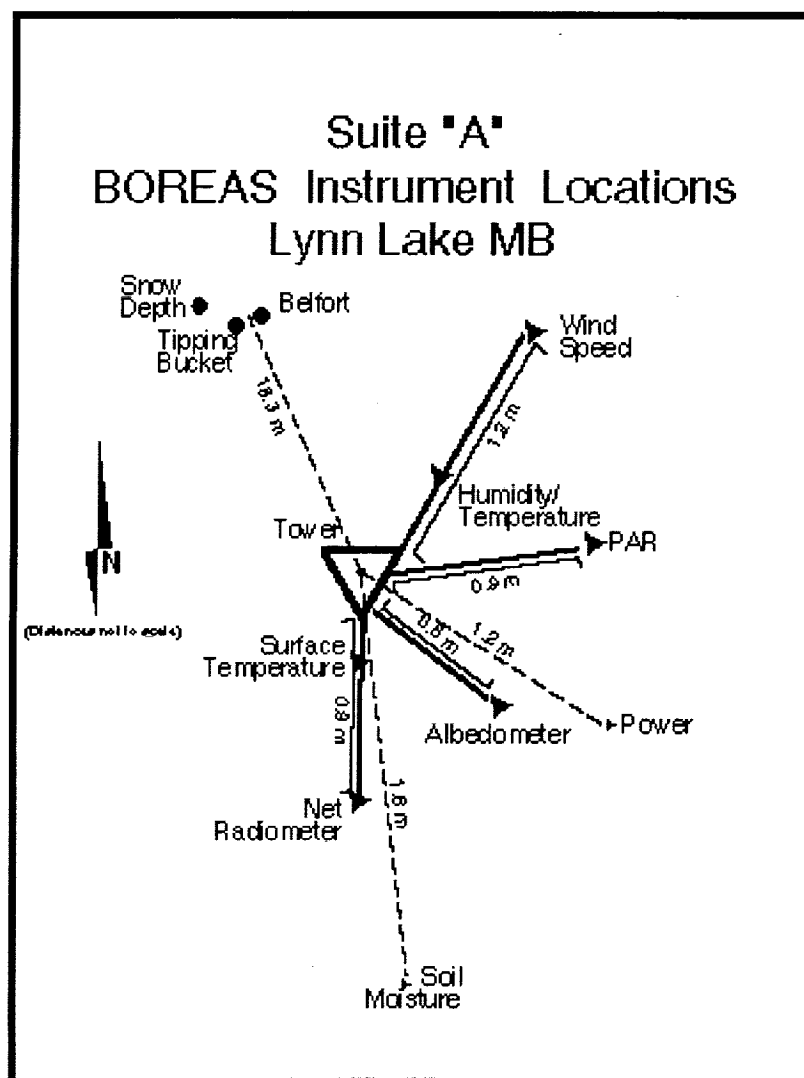
Suite B Instrument (co-located)

| | |
|-------------------|--------|
| Pyrogeometer | 1.53 m |
| Pyranometer | 1.58 m |
| Shadow Band Stand | 1.58 m |

Height on tower/Location

| | |
|----------------------------|---------|
| PAR | 0.88 m |
| DIFFUSE | 1.90 m |
| ALBEDOMETERS | 0.30 m |
| NET RADIOMETER | 1.15 m |
| PYROGEOMETER | 1.60 m |
| SNOW DEPTH SENSOR | 0.57 m |
| AIR TEMPERATURE / HUMIDITY | 1.33 m |
| SIDWALK | 3.13 m |
| TIPPING BUCKET | 0.63 m |
| SOIL TEMPERATURES | 1.04 m |
| SOIL MOISTURE | 6.8 m |
| DATA LOGGER | 7.0 m |
| Underground Instrument Hut | 7.0 m |
| PRESSURE GAUGE | 2.69 m |
| BELFORT | 7.23 m |
| WIND SPEED / DIRECTION | 22.20 m |

Lynn Lake, MB

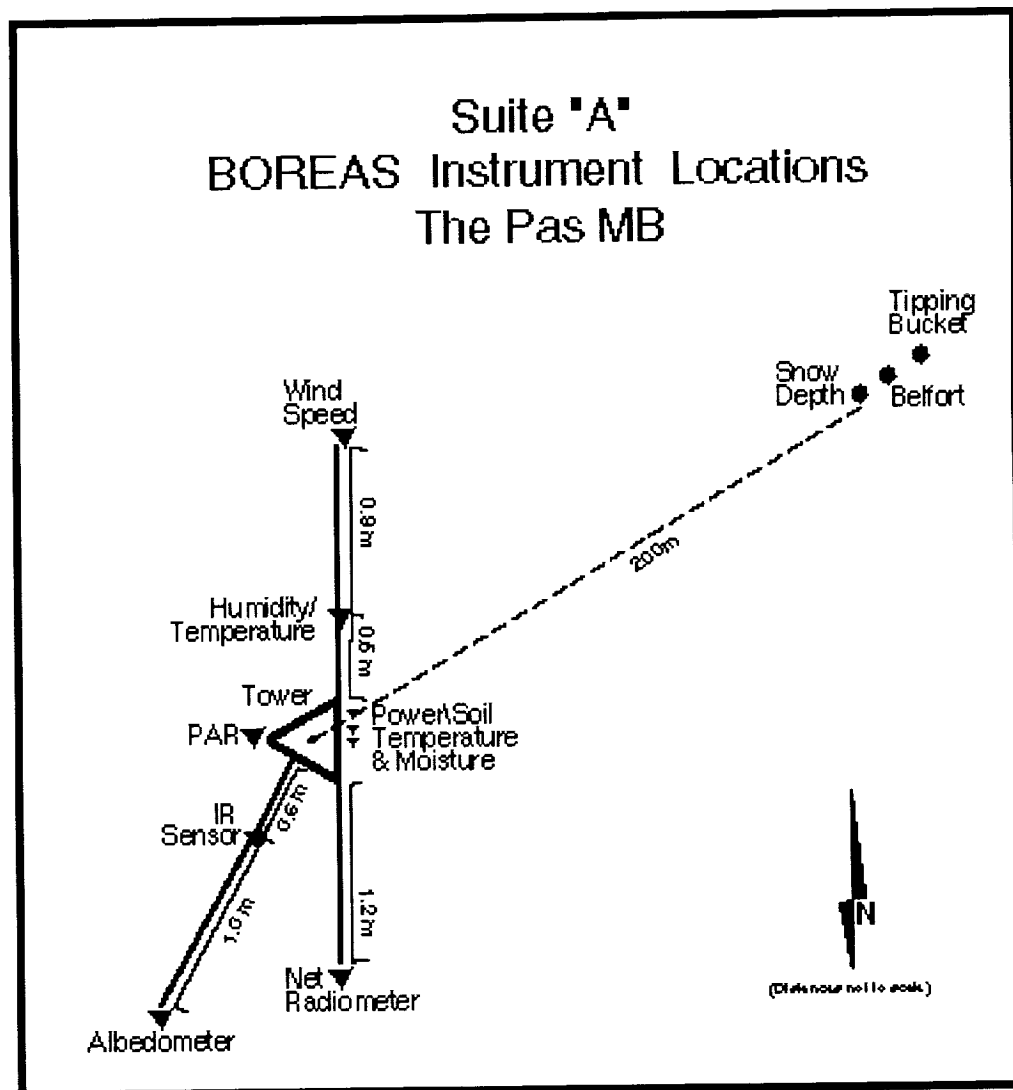


Suite A Instrument

Height on tower/Location

| | |
|-------------------------------------|--|
| PAR radiometer | 15.2 m |
| Net radiometer | 15.2 m |
| Albedometer | 15.2 m |
| Temperature/relative humidity probe | 15.2 m |
| Lower canopy temperature probe | 2.6 m |
| Soil temperature probe | -10 cm, 1.8 m south of tower |
| Soil temperature probe | -20 cm, 1.8 m south of tower |
| Soil temperature probe | -50 cm, 1.8 m south of tower |
| Barometric pressure | 9.3 m |
| IR temperature | 15.2 m |
| Wind monitor | 15.2 m |
| Belfort precipitation gauge | 8.3 m north-northwest of tower |
| Snow depth gauge | 1700 cm, 18.3 m north-northwest of tower |
| Soil moisture sensor | -10 cm, 1.8 m south of tower |
| Tipping bucket precipitation | 18.3 m southeast of tower |

The Pas, MB



Suite A Instrument

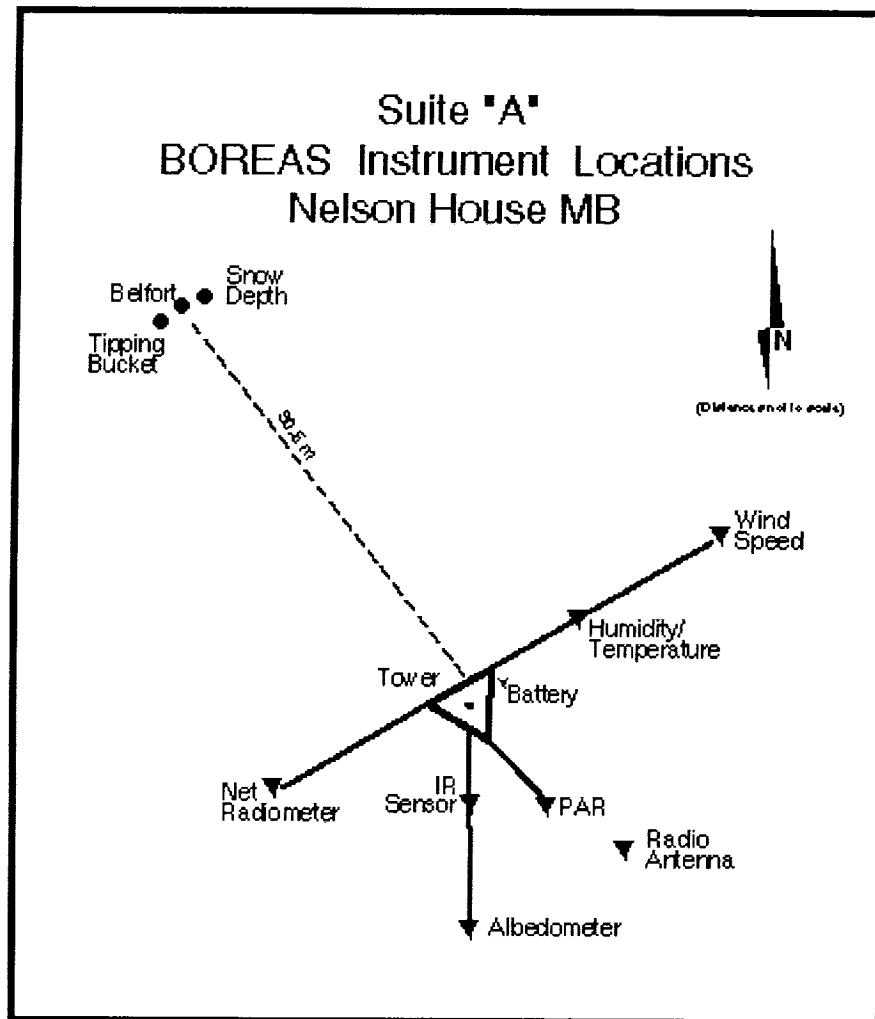
PAR radiometer
 Net radiometer
 Albedometer
 Temperature/relative humidity probe
 Lower canopy temperature probe
 Soil temperature probe
 Soil temperature probe
 Soil temperature probe
 Barometric pressure
 IR temperature
 Wind monitor
 Belfort precipitation gauge
 Snow depth gauge
 Soil moisture sensor
 Tipping bucket precipitation

Height on tower/Location

21.9 m
 21.9 m
 21.9 m
 21.9 m
 2.1 m
 -10 cm, slightly east of tower
 -20 cm, slightly east of tower
 -50 cm, slightly east of tower
 18.9 m
 21.9 m
 21.9 m
 200 m northeast of tower
 1920 cm, 200 m northeast of tower
 -10 cm, slightly east of tower
 200 m northeast of tower

BOREAS NSA-OJP (Suite A)

(Suite B instruments are at the NSA-Fen site, approximately 15 km from the NSA-OJP)

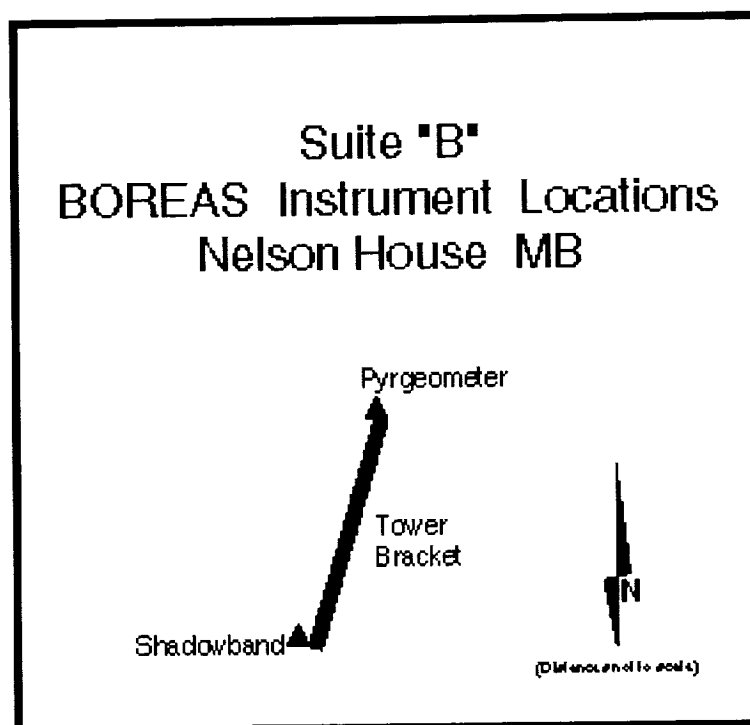


Suite A Instrument

Height on tower/Location

| | |
|-------------------------------------|-----------------------------|
| PAR radiometer | 18.5 m |
| Net radiometer | 18.5 m |
| Albedometer | 18.5 m |
| Temperature/relative humidity probe | 18.5 m |
| Lower canopy temperature probe | 4.6 m |
| Soil temperature probe | -10 cm, Not available |
| Soil temperature probe | -20 cm, Not available |
| Soil temperature probe | -50 cm, Not available |
| Barometric pressure | 16.2 m, north of the tower |
| IR temperature | 18.5 m |
| Wind monitor | 18.5 m |
| Belfort precipitation gauge | northwest of tower |
| Snow depth gauge | 2200 cm, northwest of tower |
| Soil moisture sensor | -10 cm, Not available |
| Tipping bucket precipitation | northwest of tower |

BOREAS NSA-Fen (Suite B)



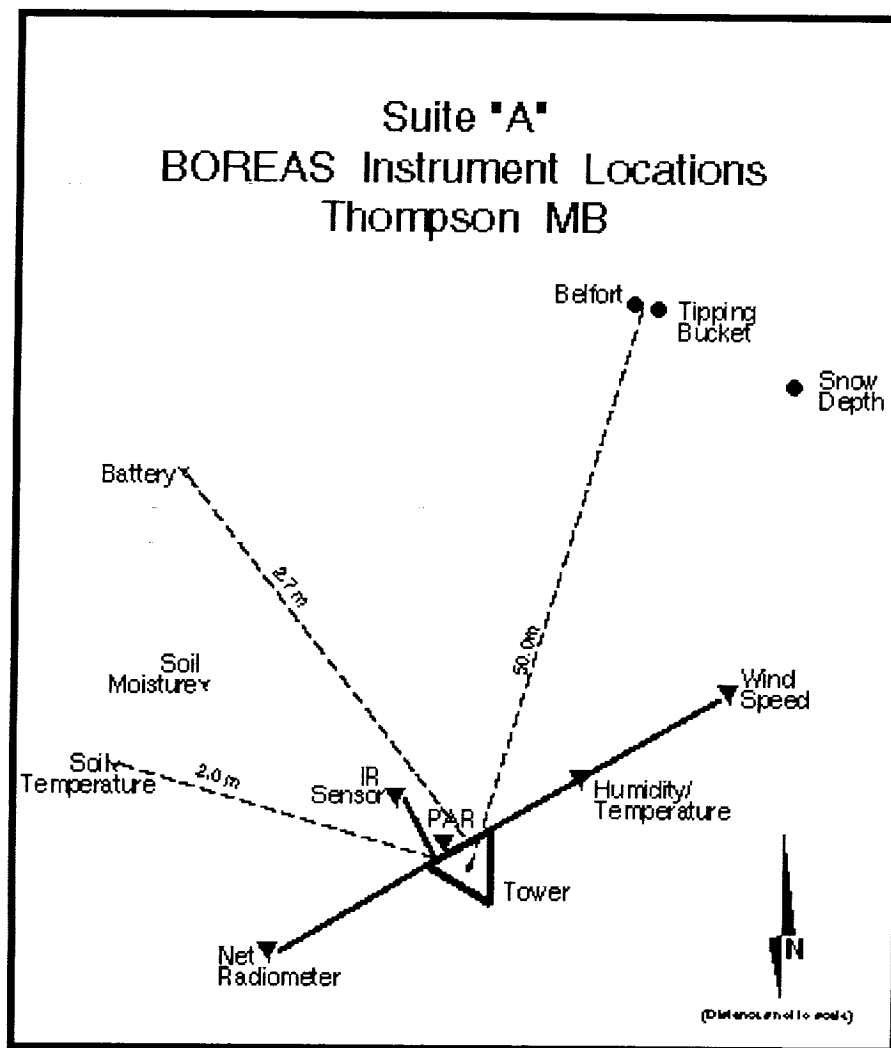
Suite B Instrument

Pyrometer
Pyranometer
Shadow Band Stand

Height on tower/Location

3.7 m
3.7 m
3.7 m

Thompson, MB

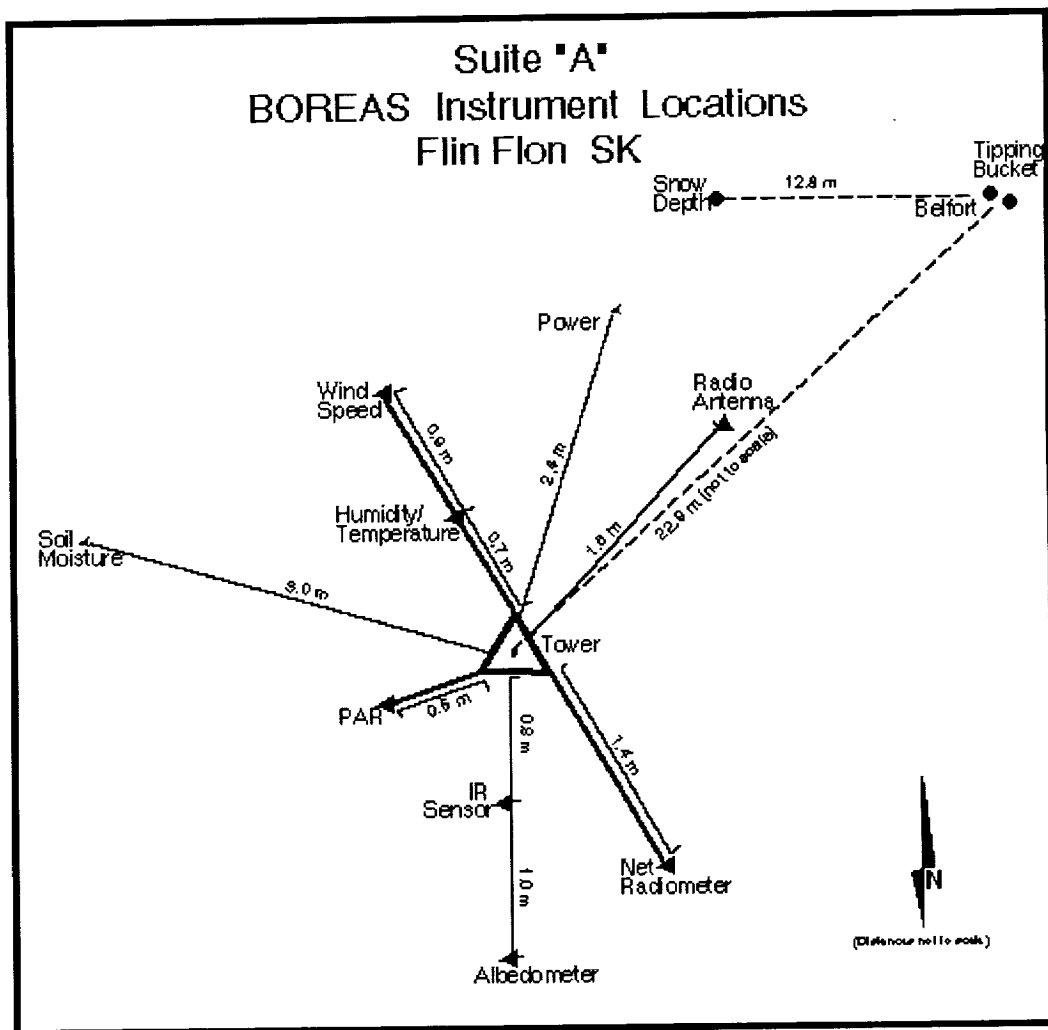


Suite A Instrument

Height on tower/Location

| | |
|-------------------------------------|---------------------------------------|
| PAR radiometer | 18.9 m |
| Net radiometer | 18.9 m |
| Albedometer | 18.9 m |
| Temperature/relative humidity probe | 18.9 m |
| Lower canopy temperature probe | 1.8 m |
| Soil temperature probe | -10 cm, 2 m northwest of the tower |
| Soil temperature probe | -20 cm, 2 m northwest of the tower |
| Soil temperature probe | -50 cm, 2 m northwest of the tower |
| Barometric pressure | 5.5 m |
| IR temperature | 18.9 m |
| Wind monitor | 18.9 m |
| Belfort precipitation gauge | 7.3 m, 10 m northeast of tower |
| Snow depth gauge | 2100 cm, 50 m east-northeast of tower |
| Soil moisture sensor | -10 cm, Not available |
| Tipping bucket precipitation | 50 m east-northeast of tower |

Flin Flon, SK (Suite A)



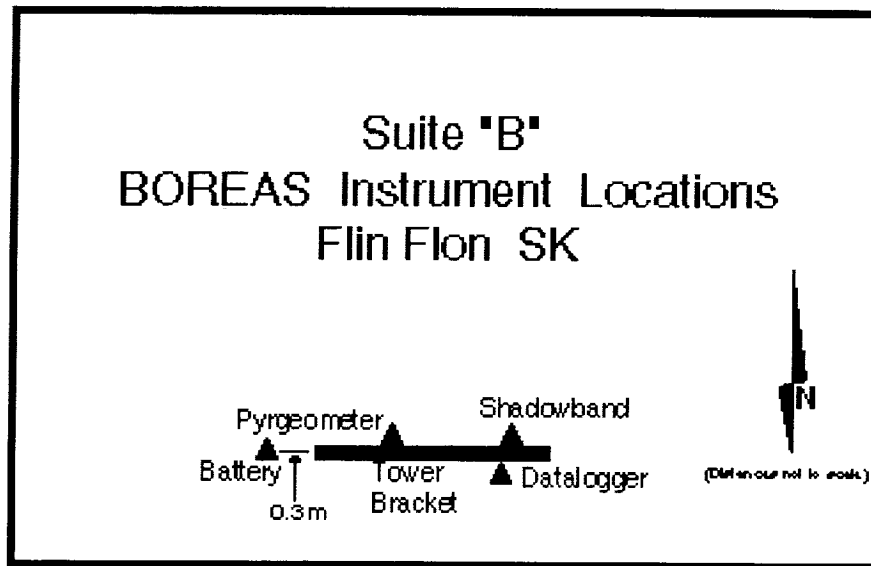
Suite A Instrument

PAR radiometer
 Net radiometer
 Albedometer
 Temperature/relative humidity probe
 Lower canopy temperature probe
 Soil temperature probe
 Soil temperature probe
 Soil temperature probe
 Barometric pressure
 IR temperature
 Wind monitor
 Belfort precipitation gauge
 Snow depth gauge
 Soil moisture sensor
 Tipping bucket precipitation

Height on tower/Location

17.9 m
 17.9 m
 17.9 m
 17.9 m
 2.2 m
 -10 cm, 3 m northwest of the tower
 -20 cm, 3 m northwest of the tower
 -50 cm, 3 m northwest of the tower
 2.8 m, north of the tower
 17.9 m
 17.9 m
 22.9 m northeast of the tower
 1900 cm, 21 northeast of the tower
 -10 cm, 3 m northwest of the tower
 22.9 m northeast of the tower

Flin Flon, SK (Suite A)



Suite B Instrument

Pyrgometer

Pyranometer

Shadow Band Stand

Height on tower/Location

1.7 m

2.0 m

2.0 m

4.1.7 Manufacturer of Sensor/Instrument

| Instrument | Model | Manufacturer |
|---|---|---|
| PAR radiometer | Skye Single Channel PAR Sensor | Skye Instruments Ltd. |
| Net radiometer | Fritschen Q-6 Net Radiometer | Radiation and Energy Balance Systems, Inc. |
| Albedometer (Solar and reflected) | Eppley Model PSP Precision Spectral Pyranometers | The Eppley Laboratory, Inc. |
| Temperature and relative humidity probe | Model HMP35CF Temperature and Relative Humidity Probe | Campbell Scientific |
| Lower canopy temperature probe | Model 107F Temperature Probe | Campbell Scientific |
| Soil temperature probe | Model 108BAM Temperature Probe | Campbell Scientific |
| Barometric pressure sensor | Model SBP270 Barometric Pressure Sensor | Setra |
| IR temperature sensor | Model 4000AL Infrared Thermometer | Everest Interscience |
| Wind monitor | Model 05103-10 Wind Monitor | R.M. Young |
| Belfort precipitation gauge | Belfort Rainfall Transmitter | Manufactured by: Belfort Instrument Company |
| Snow depth gauge | UDG01 Ultrasonic Depth Gauge | Campbell Scientific |
| Soil moisture sensor | Matrix Water Potential Soil Moisture Sensor | Matrix |
| Tipping bucket precipitation gauge | Model TE525 Tipping Bucket Rain Gauge | Texas Electronics |
| Pyrgeometer | Model PIR Precision Infrared Radiometer | The Eppley Laboratory, Inc. |
| Pyranometer | Model PSP Precision Pyranometer | The Eppley Laboratory, Inc. |
| Shadow band stand | - | The Eppley Laboratory, Inc. |

The following section lists the instrument serial numbers by site.

La Ronge

Suite A Instrument

| | Serial Number |
|---|------------------------------------|
| PAR radiometer | SKE51006937019 |
| Net radiometer | Q94175 |
| Albedometer - Solar | 29804F3 |
| Albedometer - Reflected | 29805F3 |
| Temperature and relative humidity probe | C1036 |
| Lower canopy temperature probe | C1240 |
| Soil temperature probe at -10 cm | C1825 |
| Soil temperature probe at -20 cm | C1798 |
| Soil temperature probe at -50 cm | C1827 |
| Barometric Pressure | 395165 |
| IR Temperature | 2608-6 |
| Wind monitor | 14637 |
| Belfort precipitation gauge | manufacturer: 11462, bucket: 16470 |
| Snow depth gauge | C1506 |
| Soil moisture sensor | 1045 |
| Tipping bucket precipitation gauge | TB0230001 |

Meadow Lake

Suite A Instrument

| | Serial Number |
|---|----------------------|
| PAR radiometer | SKE51006937027 |
| Net radiometer | 87122 |
| Albedometer - Solar | 29798F3 |
| Albedometer - Reflected | 29799F3 |
| Temperature and relative humidity probe | C1049 |
| Soil temperature probe at -10 cm | C1829 |
| Soil temperature probe at -20 cm | C1809 |
| Soil temperature probe at -50 cm | C1801 |
| Barometric Pressure | 395172 |
| Wind monitor | 14276 |
| Belfort precipitation gauge | manufacturer: 1946 |
| Snow depth gauge | C1187 |
| Soil moisture sensor | 1046 |
| Tipping bucket precipitation gauge | 13274-394 |

BOREAS SSA-OA**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937020 |
| Net radiometer | 93233 |
| Albedometer - Solar | 29803F3 |
| Albedometer - Reflected | 29802F3 |
| Temperature and relative humidity probe | C1052 |
| Lower canopy temperature probe | C1238 |
| Soil temperature probe at -10 cm | C1819 |
| Soil temperature probe at -20 cm | C1802 |
| Soil temperature probe at -50 cm | C1810 |
| Barometric Pressure | 330019 |
| IR Temperature | 2608-7 |
| Wind monitor | 14688 |
| Belfort precipitation gauge | manufacturer: 11401 |
| Snow depth gauge | C1339 |
| Soil moisture sensor | 1044 |
| Tipping bucket precipitation gauge | Not available |

Suite B Instrument

| | |
|-------------------|--------------------------|
| Pyrgeometer | Serial Number 29752F3 |
| Pyranometer | 29091F3 |
| Shadow band stand | 9906 |

BOREAS SSA-OJP**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937028 |
| Net radiometer | 94174 |
| Albedometer - Solar | 29878F3 |
| Albedometer - Reflected | 29879F3 |
| Temperature and relative humidity probe | C1048 |
| Lower canopy temperature probe | C1235 |
| Soil temperature probe at -10 cm | C1818 |
| Soil temperature probe at -20 cm | C1817 |
| Soil temperature probe at -50 cm | C1812 |
| Barometric Pressure | 395174 |
| IR Temperature | 2608-5 |
| Wind monitor | 15039 |
| Belfort precipitation gauge | manufacturer: 4845 |
| Snow depth gauge | C1507 |
| Soil moisture sensor | 1040 |
| Tipping bucket precipitation gauge | TB023002 |

Suite B Instrument

| | |
|-------------------|--------------------------|
| Pyrgeometer | Serial Number 28809F3 |
| Pyranometer | 2987F3 |
| Shadow band stand | Not available |

Saskatoon**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937026 |
| Net radiometer | Q94064 |
| Albedometer - Solar | 29796F3 |
| Albedometer - Reflected | 29797F3 |
| Temperature and relative humidity probe | C1051 |
| Soil temperature probe at -10 cm | Not available |
| Soil temperature probe at -20 cm | Not available |
| Soil temperature probe at -50 cm | Not available |
| Barometric Pressure | 482535 |
| Wind monitor | 14294 |
| Belfort precipitation gauge | manufacturer: 1146-2 |
| Snow depth gauge | C1521 |
| Soil moisture sensor | 1043 |
| Tipping bucket precipitation gauge | Not available |

Suite B Instrument

| | |
|-------------------|------------------------|
| Pyrgeometer | Serial Number 29750 |
| Pyranometer | 29718 |
| Shadow band stand | Not available |

Lynn Lake**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937025 |
| Net radiometer | 93231 |
| Albedometer - Solar | 29792F3 |
| Albedometer - Reflected | 29793F3 |
| Temperature and relative humidity probe | C1025 |
| Lower canopy temperature probe | C1241 |
| Soil temperature probe at -10 cm | C1797 |
| Soil temperature probe at -20 cm | C1814 |
| Soil temperature probe at -50 cm | C1811 |
| Barometric Pressure | 395166 |
| IR Temperature | 2608-8 |
| Wind monitor | 15047 |
| Belfort precipitation gauge | manufacturer: 5846 |
| Snow depth gauge | C1516 |
| Soil moisture sensor | 1037 |
| Tipping bucket precipitation gauge | Not available |

The Pas**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937018 |
| Net radiometer | 93214 |
| Albedometer - Solar | 29791F3 |
| Albedometer - Reflected | 29790F3 |
| Temperature and relative humidity probe | C1053 |
| Lower canopy temperature probe | C1239 |
| Soil temperature probe at -10 cm | C1821 |
| Soil temperature probe at -20 cm | C1804 |
| Soil temperature probe at -50 cm | C1831 |
| Barometric Pressure | 395172 |
| IR Temperature | 2608-3 |
| Wind monitor | 14252 |
| Belfort precipitation gauge | manufacturer: 4810 |
| Snow depth gauge | C1339 |
| Soil moisture sensor | 1036 |
| Tipping bucket precipitation gauge | TB37982-64 |

BOREAS NSA-OJP and NSA-Fen**Suite A Instrument**

| | |
|---|---------------------------------|
| PAR radiometer | Serial Number SKE51006937023 |
| Net radiometer | 93236 |
| Albedometer - Solar | 29806F3 |
| Albedometer - Reflected | 29807F3 |
| Temperature and relative humidity probe | C1053 |
| Lower canopy temperature probe | C1234 |
| Soil temperature probe at -10 cm | C1823 |
| Soil temperature probe at -20 cm | C1806 |
| Soil temperature probe at -50 cm | C1808 |
| Barometric Pressure | 395168 |
| IR Temperature | 2608-9 |
| Wind monitor | 14681 |
| Belfort precipitation gauge | manufacturer: Not available |
| Snow depth gauge | C1505 |
| Soil moisture sensor | 1039 |
| Tipping bucket precipitation gauge | Not available |

Suite B Instrument

| | |
|-------------------|--------------------------|
| Pyrgometer | Serial Number 29754F3 |
| Pyranometer | 29721F3 |
| Shadow band stand | Not available |

Thompson**Suite A Instrument**

| | Serial Number |
|---|----------------------|
| PAR radiometer | SKE51006937022 |
| Net radiometer | 93213 |
| Albedometer - Solar | 29876F3 |
| Albedometer - Reflected | 29877F3 |
| Temperature and relative humidity probe | C1187 |
| Lower canopy temperature probe | C1233 |
| Soil temperature probe at -10 cm | C1807 |
| Soil temperature probe at -20 cm | C1832 |
| Soil temperature probe at -50 cm | C1805 |
| Barometric Pressure | 414247 |
| IR Temperature | 2608-1 |
| Wind monitor | 14288 |
| Belfort precipitation gauge | manufacturer: 5-4057 |
| Snow depth gauge | C1341 |
| Soil moisture sensor | 1038 |
| Tipping bucket precipitation gauge | Not available |

Flin-Flon**Suite A Instrument**

| | Serial Number |
|---|----------------------|
| PAR radiometer | SKE51006937021 |
| Net radiometer | 93232 |
| Albedometer - Solar | 29795F3 |
| Albedometer - Reflected | 29794F3 |
| Temperature and relative humidity probe | C1193 |
| Lower canopy temperature probe | C1518 |
| Soil temperature probe at -10 cm | C1820 |
| Soil temperature probe at -20 cm | C1828 |
| Soil temperature probe at -50 cm | C1815 |
| Barometric Pressure | 414249 |
| IR Temperature | 2608-2 |
| Wind monitor | 15045 |
| Belfort precipitation gauge | manufacturer: 4810 |
| Snow depth gauge | C1518 |
| Soil moisture sensor | 1041 |
| Tipping bucket precipitation gauge | TB37983-64 |

Suite B Instrument

| | Serial Number |
|-------------------|----------------------|
| Pyrgeometer | 29751F3 |
| Pyranometer | 29093F3 |
| Shadow band stand | Not available |

4.2 Calibration

4.2.1 Specifications

The following tables give the calibration multiplier and constant (if applicable) for each instrument at each site.

La Ronge

Suite A Instrument Type

| | Multiplier | Calibration Constant |
|---|-------------------|--|
| PAR radiometer | 0.5 | None given |
| Net radiometer | 0.07 | 14.0 w ² /(mVm ²) |
| Albedometer - Solar | 0.5954530 | 8.41 microV/wm ² |
| Albedometer - Reflected | 0.56947 | 8.78 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) | 10 feet |
| | 0.1 (humidity) | - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | 80 |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) | None given |
| | 0.071 (direction) | - |
| Belfort precipitation gauge | 0.078259 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.03 | None given |

Meadow Lake

Suite A Instrument Type

| | Multiplier | Calibration Constant |
|---|-------------------|--|
| PAR radiometer | 0.5 | None given |
| Net radiometer | 0.0505 | 10.1 w ² /(mVm ²) |
| Albedometer - Solar | 0.639391 | 7.82 microV/wm ² |
| Albedometer - Reflected | 0.60459 | 8.27 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) | 100 feet |
| | 0.1 (humidity) | - |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | 80 |
| Wind monitor | 0.098 (speed) | None given |
| | 0.071 (direction) | - |
| Belfort precipitation gauge | Not available | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.25 | None given |

BOREAS SSA-OA**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|--|
| PAR radiometer | 0.5 | None given |
| Net radiometer | 0.0665 | 13.3 w ² /(mVm ²) |
| Albedometer - Solar | 0.55741 | 8.97 microV/wm ² |
| Albedometer - Reflected | 0.55991 | 8.93 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | 100 feet - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | None given |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | 0.07386 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.024 | None given |

Suite B Instrument Type

| | Multiplier | Calibration Constant |
|-------------|-------------------|-----------------------------|
| Pyrgeometer | None given | None given |
| Pyranometer | None given | None given |

BOREAS SSA-OJP**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|--|
| PAR radiometer | None given | None given |
| Net radiometer | None given | 13.3 w ² /(mVm ²) |
| Albedometer - Solar | 0.58616 | 8.97 microV/wm ² |
| Albedometer - Reflected | 0.57013 | 8.93 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | 35 feet - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | None given | None given |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | 0.07824 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.025 | None given |

Suite B Instrument Type

| | Multiplier | Calibration Constant |
|-------------|-------------------|-----------------------------|
| Pyrgeometer | None given | 2.76 W/m ² |
| Pyranometer | None given | 8.77 W/m ² |

Saskatoon**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|-----------------------------|
| PAR radiometer | None given | None given |
| Net radiometer | None given | None given |
| Albedometer - Solar | 1.1891 | 8.97 microV/wm ² |
| Albedometer - Reflected | 1.1416 | 8.93 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | 10 feet - |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | None given | None given |
| Snow depth gauge | None given | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.2 | None given |

Suite B Instrument Type

| | Multiplier | Calibration Constant |
|-------------|-------------------|-----------------------------|
| Pyrgeometer | None given | None given |
| Pyranometer | None given | None given |

Lynn Lake**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|--|
| PAR radiometer | 0.5 | Not available |
| Net radiometer | 0.066 | 13.2 w ² /(mVm ²) |
| Albedometer - Solar | 0.60533 | 8.26 microV/wm ² |
| Albedometer - Reflected | 0.59312 | 8.43 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | 35 feet - |
| Lower canopy temperature probe | 35 feet | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | None given |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | 0.07181 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.025 | None given |

The Pas**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|---|
| PAR radiometer | 0.5 | Not available |
| Net radiometer | 0.065 | 13.0 $\text{W}^2/(\text{mV}\text{m}^2)$ |
| Albedometer - Solar | 0.58824 | 8.50 $\mu\text{V}/\text{W}\text{m}^2$ |
| Albedometer - Reflected | 0.62035 | 8.06 $\mu\text{V}/\text{W}\text{m}^2$ |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | 35 feet - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | None given |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | 0.07155 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.05 | None given |

BOREAS NSA-OJP and NSA-Fen**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|------------------------------------|---|
| PAR radiometer | None given | None given |
| Net radiometer | 0.0645 | 12.9 $\text{W}^2/(\text{mV}\text{m}^2)$ |
| Albedometer - Solar | 0.59595 | 8.39 $\mu\text{V}/\text{W}\text{m}^2$ |
| Albedometer - Reflected | 0.61652 | 8.11 $\mu\text{V}/\text{W}\text{m}^2$ |
| Temperature and relative humidity probe | 0.001 (temp) 0.1 (humidity) | None given - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | 80 |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) 0.071 (direction) | None given - |
| Belfort precipitation gauge | 0.07824 | None given |
| Snow depth gauge | None given | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | 0.025 | None given |

Suite B Instrument Type

| | Multiplier | Calibration Constant |
|-------------|-------------------|-----------------------------|
| Pyrgeometer | None given | 3.42 W/m^2 |
| Pyranometer | None given | 8.55 W/m^2 |

Thompson**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|-------------------|--|
| PAR radiometer | 0.5 | Not available |
| Net radiometer | 0.0645 | 12.9 w ² /(mVm ²) |
| Albedometer - Solar | 0.58343 | 8.57 microV/wm ² |
| Albedometer - Reflected | 0.57274 | 8.73 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) | 10 feet |
| | 0.1 (humidity) | - |
| Lower canopy temperature probe | 0.001 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | 0.12 | 80 |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) | None given |
| | 0.071 (direction) | - |
| Belfort precipitation gauge | 0.11518 | None given |
| Snow depth gauge | 1.0 | None given |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | None given | None given |

Flin-Flon**Suite A Instrument Type**

| | Multiplier | Calibration Constant |
|---|-------------------|--|
| PAR radiometer | None given | None given |
| Net radiometer | 0.066 | 13.2 w ² /(mVm ²) |
| Albedometer - Solar | 0.56948 | 8.89 microV/wm ² |
| Albedometer - Reflected | 0.56370 | 8.21 microV/wm ² |
| Temperature and relative humidity probe | 0.001 (temp) | None given |
| | 0.1 (humidity) | - |
| Lower canopy temperature probe | 0.12 | None given |
| Soil temperature probe at -10 cm | None given | None given |
| Soil temperature probe at -20 cm | None given | None given |
| Soil temperature probe at -50 cm | None given | None given |
| Barometric Pressure | None given | None given |
| IR Temperature | None given | None given |
| Wind monitor | 0.098 (speed) | None given |
| | 0.071 (direction) | - |
| Belfort precipitation gauge | 1 | None given |
| Snow depth gauge | None given | 39 |
| Soil moisture sensor | None given | None given |
| Tipping bucket precipitation gauge | None given | None given |

Suite B Instrument Type

| | Multiplier | Calibration Constant |
|-------------|-------------------|-----------------------------|
| Pygeometer | None given | None given |
| Pyranometer | None given | None given |

4.2.1.1 Tolerance

The following list gives information relating to the tolerances of the instruments used:

| Instrument | Tolerance |
|---|--|
| PAR radiation | Without filters, this instrument is sensitive to electromagnetic energy with wavelengths between 300 and 1000 nanometers. The instrument contains glass and metal interference filters that cut the response to between 400 and 700 nanometers. |
| Net radiation | A 5 degree error in leveling the net radiometer may result in an error of up to 6 percent under normal conditions (e.g. the sun is relatively high in the sky). Errors greater than 6 percent may occur when the sun is near the horizon. |
| Albedometer | The albedometers used in the BOREAS study are sensitive to electromagnetic energy with wavelengths between 285 and 2800 nanometers. |
| Temperature and relative humidity probe | The temperature piece of this ensemble has an accuracy rating of $\pm 0.4^{\circ}\text{C}$ over a temperature range from -53 to $+48^{\circ}\text{C}$. The humidity probe has an accuracy of ± 2 percent relative humidity from 0 to 90 percent and a rating of ± 3 percent over a relative humidity of 90 percent. |
| Lower canopy temperature probe | This probe has an accuracy rating of $\pm 0.4^{\circ}\text{C}$ over a temperature range from -53 to $+48^{\circ}\text{C}$. |
| Soil temperature probes | The soil temperature probes located at the BOREAS sites have an accuracy of $\pm 0.4^{\circ}\text{C}$ over a range of temperature from -33 to $+48^{\circ}\text{C}$. |
| Barometric pressure sensor | The accuracy of the Setra SBP270 is ± 0.2 millibars. |
| IR Thermometer | None given. |
| Wind sensor | The range in wind speeds measured by the R.M. Young Wind Monitor is - to 60 meters/second with a maximum gust survival of 100 meters/second. |
| Belfort precipitation gauge | None given. |
| Snow depth sensor | The snow depth sensor can measure depths between 0.6 meters and 10 meters with an accuracy of ± 1 centimeter or 0.4 percent of the distance from the sensor to the target. The vertical resolution of the sensor is 0.5 millimeters. |
| Soil moisture | None given. |
| Tipping bucket precipitation gauge | None given. |
| Pyrgeometer | The Eppley pyrgeometer has a temperature dependence of ± 2 percent when the temperature is between -20 and $+40^{\circ}\text{C}$. |
| Pyranometer | The pyranometers used for Suite B sites have a temperature dependence of ± 1 percent over a range in ambient temperatures from -20 to $+40^{\circ}\text{C}$. |

4.2.2 Frequency of Calibration

All instruments were calibrated by the manufacturer or by SRC before being installed in the sites. Most of the instruments were again calibrated at the end of March 1994 during the spring inspection tour. Due to the shortness of the experiments, the instruments were not required to have full laboratory calibrations.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

The AMS system installed for BOREAS consists of transportable computerized weather observing stations that routinely measure wind, temperature, humidity, pressure, and precipitation at all stations. The stations are equipped to measure soil temperature; surface radiative temperature; shortwave, net, and infrared radiation; and soil moisture. Most of the instruments are scanned every 5 seconds and averaged every 15 minutes. Many of the stations are powered by solar panels, thereby enabling them to be located remotely without the need for commercial power. Data are collected via a modem and commercial phone lines. The data are downloaded every 6 hours to the base station at SRC. A computerized limit checker examines the data to be sure they are within specified limits. SRC staff performed quality checking and once per month sent the Suite A data to BORIS in Lotus 123 version 3.1 format.

Suite B station data were also collected every 5 seconds. Individual storage modules were sent to SSA-OA, SSA-OJP, and Flin Flon once per month. The onsite observer exchanged the modules and sent the previous month's module back to SRC via courier. NSA-OJP and Saskatoon data were downloaded to the SRC via phone lines. At SRC, the data underwent quality checking before being sent to BORIS in ASCII format.

6. Observations

6.1 Data Notes

Detailed notes on site maintenance and problems are given in Section 11.

6.2 Field Notes

Detailed notes on site maintenance and problems are given in Section 11.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The SRC AMS data collected for BOREAS cover an area of roughly 1,000 by 1,000 kilometers over much of northern Saskatchewan and Manitoba. The list below provides the North American Datum of 1983 (NAD83) coordinates and descriptions for all of the SRC AMS sites.

| BOREAS Site | Spatial Coverage |
|--|---|
| La Ronge (55 07'31"N 105 17'35"W; Elevation 381 m; Site ID ZBG) | This site has the full complement of Suite A sensors. The dominant vegetation types in the area are spruce and poplar trees that extend to a height of roughly 11.5 meters in the area immediately surrounding the tower. This site is approximately 1 km away from the town of La Ronge. |
| Meadow Lake (54 07'28"N 108 31'21"W; Elevation 480 m; Site ID ZBH) | This site contains only a partial complement of Suite A instrumentation. It does not include IR radiation or Lower canopy temperature probe. All other Suite A instruments are at this location. The Meadow Lake instruments are located in an area where grassland is the dominant land cover. The few trees in the area are spruce and poplar. |
| BOREAS SSA-OA (53 37'45"N 106 11'51"W; Elevation 587 m; Site ID ZBI) | The BOREAS SSA-OA site (located in the Prince Albert National Forest) has a full complement of both the Suite A and Suite B instrumentation. This site is located in an aspen-dominated forest where the tallest parts of the canopy reach roughly 21.5 meters. This site is approximately 100 km away from the city of Prince Albert. |
| BOREAS SSA-OJP (53 54'59"N 104 41'26"W; Elevation 511 m; Site ID ZBJ) | The BOREAS SSA-OJP site (located in the Nipawin Provincial Park) contains all of the Suite A and Suite B instrumentation. This area around the tower is dominated by Jack Pine. The tallest trees in the area around the tower are roughly 16.8 meters, while the top of the tower is at 20.7 meters. This site is approximately 100 km away from the town of Nipawin. |
| Saskatoon (52 09'50"N 106 36'12"W; Elevation 480 m; Site ID ZBK) | The Saskatoon AMS site is located on a grassland area within the city of Saskatoon. The grass around the instrument site is cut approximately once per week during the growing season. This site does not include the IR sensor or the below canopy temperature sensor. The serial numbers for instruments at the Saskatoon site are missing in many cases because most of the instrument were installed over 20 years ago when the use of serial numbers was not common. |
| Lynn Lake (56 51'50"N 101 05' 33"W; Elevation 366 m; Site ID ZBL) | Lynn Lake has a full complement of Suite A instruments. This tower is located in a dense stand of Jack Pine. The maximum tree height in the area surrounding the tower is approximately 14.3 meters, while the top of the tower is at 15.2 meters. This site is approximately 20 km from the town of Lynn Lake. |
| The Pas (53 58'6"N 101 31'15"W; Elevation 267 m; Site ID ZBN) | The Pas hosts all of the Suite A instruments. The tower is located in a forest dominated by spruce and poplar that achieve a maximum height of roughly 18.3 meters. The tower itself extends to 21.9 meters. This site is approximately 15 km away from the town of The Pas. |

| | |
|--|---|
| BOREAS NSA-OJP and NSA-Fen (55 55'41"N 98 38'26"W Elevation 282 m; Site ID ZBO) | The Suite A instruments for this site are located at the BOREAS NSA-OJP tower site. The Suite B instrumentation is located at the BOREAS NSA-Fen site. The trees at the NSA-OJP site are roughly 12.8 meters tall, while the top of the tower extends to 18.9 meters. At the NSA-Fen site there are no significant trees. The shrubbery in the area of the tower is less than 5 meters tall. This site is approximately 40 km away from the settlement of Nelson House. |
| Thompson (55 48' 13"N 97 52'25"W; Elevation 221 m; Site ID ZBQ) | Thompson is a fully-instrumented Suite A AMS site. The instruments are located in an area that is dominated by spruce and poplar. The tops of the trees nearest the tower are approximately 13 meters while the top of the tower extends to 19 meters. This site is about 1 kilometer away from the town of Thompson. |
| Flin-Flon (54 40'16"N 101 41'24"W; Elevation 305 m; Site ID ZBR) | The Flin Flon AMS site contains both the Suite A and Suite B BOREAS instruments. The forest around this site is predominantly spruce and poplar, rising to a height of 13.1 meters in the vicinity of the Suite A tower. The tower itself is located on a large, flat rock (roughly 5 meters wide and 10-15 meters long). This site is about 1 kilometer away from the town of Flin Flon. |

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

The data represent point source measurements taken at the listed sites.

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Data at the BOREAS AMS sites nominally cover the period from 01-JAN-1994 to 30-NOV-1996.

7.2.2 Temporal Coverage Map

The table below gives detailed date ranges for individual sites:

| <u>Site</u> | <u>Start Date</u> | <u>End Date</u> |
|---------------------|-------------------|-----------------|
| La Ronge | 15-DEC-1993 | 30-NOV-1996 |
| Meadow Lake | 03-FEB-1994 | 30-NOV-1996 |
| BOREAS SSA-OA | 15-DEC-1993 | 30-NOV-1996 |
| BOREAS SSA-OJP | 15-DEC-1993 | 30-NOV-1996 |
| Saskatoon | 15-FEB-1994 | 30-NOV-1996 |
| Lynn Lake | 15-DEC-1993 | 30-NOV-1996 |
| The Pas | 15-DEC-1993 | 30-NOV-1996 |
| NSA-OJP and NSA-Fen | 16-JAN-1994 | 30-NOV-1996 |
| Thompson | 15-DEC-1993 | 30-NOV-1996 |
| Flin Flon | 22-DEC-1993 | 30-NOV-1996 |

Note: This table gives nominal start and end dates for data collection at site. Specific instruments did not necessarily begin or end data collection at the above times.

7.2.3 Temporal Resolution

To fully understand the microclimate of the boreal forest, it was necessary to make consistent measurements over a long time period. Consequently, the nominal sampling period did not change for the duration of the experiment. Individual cases of instrument error or data logger failure occasionally caused the period between recorded data to change. A list of known errors of this type is given in Section 11.

For the most part, the BOREAS SRC AMS sites collected data with the same sampling strategy. Samples of each variable were acquired every 5 seconds. These samples were then averaged over 15-minute periods to get the actual data values. The standard deviations given are for the 5-second samples that make up the 15-minute averages.

The exceptions to this strategy were the Belfort precipitation, snow depth, tipping bucket precipitation, and soil moisture data. The Belfort precipitation and snow depth data were sampled every minute, the reported data values for each hour are the average from minute 55 to minute 59. The tipping bucket precipitation was sampled every 5 seconds, and the data values reported are the running total every 15 minutes. The soil moisture data were sampled every 30 seconds, the data value is given at minute 50.

7.3 Data Characteristics

7.3.1 Parameter/Variable

Suite A Column Name

SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
MEAN_ABOVE_CANOPY_TEMP_10M
SDEV_ABOVE_CANOPY_TEMP_10M
MEAN_WITHIN_CANOPY_TEMP_2M
SDEV_WITHIN_CANOPY_TEMP_2M
MEAN_SURF_PRESS_15MIN
SDEV_SURF_PRESS_15MIN
MEAN_REL_HUM_15MIN
SDEV_REL_HUM_15MIN
MIXING_RATIO
MEAN_WIND_SPEED_15MIN
SDEV_WIND_SPEED_15MIN
MEAN_WIND_DIR_15MIN
SDEV_WIND_DIR_15MIN
U_COMPNT_WIND_VELOC
V_COMPNT_WIND_VELOC
RAINFALL_RATE_15MIN
TOTAL_RAINFALL_RATE_15MIN
ACCUM_PRECIP
SNOW_DEPTH
MEAN_INCIDENT_SHORTWAVE_15MIN
SDEV_INCIDENT_SHORTWAVE_15MIN
MEAN_TOTAL_DOWN_PAR_15MIN
MEAN_DOWN_PPFD_15MIN
SDEV_TOTAL_DOWN_PAR_15MIN
MEAN_REFLECTED_SHORTWAVE_15MIN
SDEV_REFLECTED_SHORTWAVE_15MIN

MEAN_NET_RAD_15MIN
 SDEV_NET_RAD_15MIN
 MEAN_IR_TEMP_15MIN
 SDEV_IR_TEMP_15MIN
 COLD_PROBE_TEMP
 WARM_PROBE_TEMP
 MEAN_SOIL_TEMP_10CM_15MIN
 SDEV_SOIL_TEMP_10CM_15MIN
 MEAN_SOIL_TEMP_20CM_15MIN
 SDEV_SOIL_TEMP_20CM_15MIN
 MEAN_SOIL_TEMP_50CM_15MIN
 SDEV_SOIL_TEMP_50CM_15MIN
 CRTFCN_CODE
 REVISION_DATE

Suite B Column Name

 SITE_NAME
 SUB_SITE
 DATE_OBS
 TIME_OBS
 MEAN_DIFFUSE_DOWN_SHORTWAVE
 SDEV_DIFFUSE_DOWN_SHORTWAVE
 MEAN_DOWN_LONGWAVE
 SDEV_DOWN_LONGWAVE
 MEAN_THERMOPILE_VOLT
 SDEV_THERMOPILE_VOLT
 MEAN_RADIOMETER_CASE_TEMP
 SDEV_RADIOMETER_CASE_TEMP
 MEAN_RADIOMETER_DOME_TEMP
 SDEV_RADIOMETER_DOME_TEMP
 REVISION_DATE
 CRTFCN_CODE

7.3.2 Variable Description/Definition

| Suite A Column Name | Description |
|---------------------|---|
| SITE_NAME | The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type. |
| SUB_SITE | The identifier assigned to the sub-site by BOREAS, in the format GGGGG-III, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and III is the identifier for sub-site, often this will refer to an instrument. |
| DATE_OBS | The date on which the data were collected. |
| TIME_OBS | The Greenwich Mean Time (GMT) when the data were |

| | |
|----------------------------|---|
| MEAN_ABOVE_CANOPY_TEMP_10M | collected. The fifteen-minute mean air temperature a few meters above the canopy [see Section 4.1.6 and 7.1.1] based on measurements taken every 5 seconds starting at the given time. |
| SDEV_ABOVE_CANOPY_TEMP_10M | The standard deviation of the air temperature a few meters above the canopy based on measurements taken every 5 seconds starting at the given time. |
| MEAN_WITHIN_CANOPY_TEMP_2M | The fifteen-minute mean air temperature at two meters above ground based on measurements taken every 5 seconds starting at the given time. |
| SDEV_WITHIN_CANOPY_TEMP_2M | The standard deviation of the air temperature at two meters above ground based on measurements taken every 5 seconds starting at the given time. |
| MEAN_SURF_PRESS_15MIN | The fifteen-minute mean atmospheric pressure measured at station level based on measurements taken every 5 seconds starting at the given time. |
| SDEV_SURF_PRESS_15MIN | The standard deviation of the atmospheric pressure measured at station level based on measurements taken every 5 seconds starting at the given time. |
| MEAN_REL_HUM_15MIN | The fifteen-minute mean relative humidity of the air a few meters above the canopy based on measurements taken every 5 seconds starting at the given time. |
| SDEV_REL_HUM_15MIN | The standard deviation of the relative humidity of the air at ten meters above the canopy based on measurements taken every 5 seconds starting at the given time. |
| MIXING_RATIO | The derived mixing ratio of the air a few meters above the canopy using the fifteen-minute mean of the above canopy temperature, surface pressure, and relative humidity. |
| MEAN_WIND_SPEED_15MIN | The fifteen-minute mean speed of the air based on measurements taken every five seconds starting at the given time. |
| SDEV_WIND_SPEED_15MIN | The standard deviation of the speed of the air based on measurements taken every five seconds starting at the given time. |
| MEAN_WIND_DIR_15MIN | The fifteen-minute mean direction from which the wind traveled based on measurements taken every five seconds starting at the given time. |
| SDEV_WIND_DIR_15MIN | The standard deviation of the direction from which the wind traveled based on measurements taken every five seconds starting at the given time. |
| U_COMPNT_WIND_VELOC | The computed westerly (from the west) vector component of the wind speed and wind direction. |
| V_COMPNT_WIND_VELOC | The computed southerly (from the south) vector component of the wind speed and wind direction. |
| RAINFALL_RATE_15MIN | The amount of rain measured by the Tipping bucket rain gauge during the fifteen minute time period starting at the given time. |
| TOTAL_RAINFALL_RATE_15MIN | The total amount of rain that has fallen since |

| | |
|--------------------------------|--|
| | the start of data collection, given as the running sum of the amount of rain that has fallen in each fifteen minute time period. |
| ACCUM_PRECIP | The total amount of precipitation measured by the Belfort gauge since a relative date. This variable is measured at the start of every hour but given for every fifteen-minute time period. |
| SNOW_DEPTH | The depth of snow on the ground. |
| MEAN_INCIDENT_SHORTWAVE_15MIN | The fifteen-minute mean total (direct and diffuse) downward shortwave solar radiation based on measurements taken every five seconds starting at the given time. Measured wavelengths range from 0.285 to 2.800 micrometers. |
| SDEV_INCIDENT_SHORTWAVE_15MIN | The standard deviation of the total (direct and diffuse) downward shortwave solar radiation based on measurements taken every five seconds starting at the given time. Measured wavelengths range from 0.285 to 2.800 micrometers. See section 9.1.1 about dividing these values by 5 to get standard deviation in Wm^{-2} |
| MEAN_TOTAL_DOWN_PAR_15MIN | The fifteen-minute mean total (direct and diffuse) downward photosynthetically active radiation based on measurements taken every five seconds starting at the given time. Measured wavelengths range from 0.4 to 0.7 micrometers. |
| MEAN_DOWN_PPFD_15MIN | The fifteen-minute mean total (direct and diffuse) quantum downward photosynthetic photon flux density calculated from the mean downward PAR using the factor $4.54 \text{ microEinstein sec}^{-1} \text{ Watts}^{-1}$ as given in McCartney, 1978. |
| SDEV_TOTAL_DOWN_PAR_15MIN | The standard deviation of the total (direct and diffuse) downward photosynthetically active radiation based on measurements taken every five seconds starting at the given time. Measured wavelengths range from 0.4 to 0.7 micrometers. See section 9.1.1 about dividing these values by 5 to get standard deviation in Wm^{-2} |
| MEAN_REFLECTED_SHORTWAVE_15MIN | The fifteen-minute mean of upward shortwave solar radiation reflected from the ground based on measurements taken every five seconds starting at the given time. Measured wavelengths are 0.285 to 2.800 micrometers. |
| SDEV_REFLECTED_SHORTWAVE_15MIN | The standard deviation of the upward shortwave solar radiation reflected from the ground based on measurements taken every five seconds starting at the given time. Measured wavelengths are 0.285 to 2.800 micrometers. See section 9.1.1 about dividing these values by 5 to get standard deviation in Wm^{-2} |
| MEAN_NET_RAD_15MIN | The fifteen-minute mean total (incoming and outgoing) radiation based on measurements taken every five seconds starting at the given time. |
| SDEV_NET_RAD_15MIN | The standard deviation of the mean total (incoming and outgoing) radiation based on |

MEAN_IR_TEMP_15MIN

SDEV_IR_TEMP_15MIN

COLD_PROBE_TEMP

WARM_PROBE_TEMP

MEAN_SOIL_TEMP_10CM_15MIN

SDEV_SOIL_TEMP_10CM_15MIN

MEAN_SOIL_TEMP_20CM_15MIN

SDEV_SOIL_TEMP_20CM_15MIN

MEAN_SOIL_TEMP_50CM_15MIN

SDEV_SOIL_TEMP_50CM_15MIN

CRTFCN_CODE

REVISION_DATE

measurements taken every five seconds starting at the given time. See section 9.1.1 about dividing the values by 5 to get standard deviation in Wm-2. The fifteen-minute mean infrared temperature looking down from ten meters above the canopy based on measurements taken every five seconds starting at the given time.

The standard deviation of the infrared temperature looking down from ten meters above the canopy based on measurements taken every five seconds starting at the given time.

The temperature of a probe inserted into a porous block in the soil at ten centimeters depth before the block area is heated.

The temperature of a probe inserted into a porous block in the soil at ten centimeters depth after the block area has been heated for twenty seconds.

The fifteen-minute mean temperature of the soil at ten centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The standard deviation of the soil temperature at ten centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The fifteen-minute mean temperature of the soil at twenty centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The standard deviation of the soil temperature at twenty centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The fifteen-minute mean temperature of the soil at fifty centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The standard deviation of the soil temperature at fifty centimeters below the surface based on measurements taken every 5 seconds starting at the given time.

The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).

The most recent date when the information in the referenced data base table record was revised.

| Suite B Column Name | Description |
|-----------------------------|---|
| SITE_NAME | The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type. |
| SUB_SITE | The identifier assigned to the sub-site by BOREAS, in the format GGGGG-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII is the identifier for sub-site, often this will refer to an instrument. |
| DATE_OBS | The date on which the data were collected. |
| TIME_OBS | The Greenwich Mean Time (GMT) when the data were collected. |
| MEAN_DIFFUSE_DOWN_SHORTWAVE | The fifteen-minute mean diffuse downward shortwave solar radiation. Measured wavelengths range from 0.285 to 2.800 micrometers. |
| SDEV_DIFFUSE_DOWN_SHORTWAVE | The standard deviation of the diffuse downward shortwave solar radiation. Measured wavelengths range from 0.285 to 2.800 micrometers. See section 9.1.1 about dividing these values by 5 to get standard deviation in Wm-2 |
| MEAN_DOWN_LONGWAVE | The fifteen-minute mean total (direct and diffuse) downward longwave radiation. Measured wavelengths range from 4 to 50 micrometers. |
| SDEV_DOWN_LONGWAVE | The standard deviation of the total (direct and diffuse) downward longwave radiation. Measured wavelengths range from 4 to 50 micrometers. See section 9.1.1 about dividing these values by 5 to get standard deviation in Wm-2 |
| MEAN_THERMOPILE_VOLT | The fifteen minute mean of the thermopile voltage based on measurements taken every five seconds starting at the given time. |
| SDEV_THERMOPILE_VOLT | The standard deviation of the thermopile voltage based on measurements taken every five seconds starting at the given time. |
| MEAN_RADIOMETER_CASE_TEMP | The mean temperature of the radiometer's case. |
| SDEV_RADIOMETER_CASE_TEMP | The standard deviation of the temperature of the radiometer's case. |
| MEAN_RADIOMETER_DOME_TEMP | The mean temperature of the radiometer's dome. |
| SDEV_RADIOMETER_DOME_TEMP | The standard deviation of the radiometer's dome temperature. |
| REVISION_DATE | The most recent date when the information in the referenced data base table record was revised. |
| CRTFCN_CODE | The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable). |

7.3.3 Unit of Measurement

| Suite A Column Name | Units |
|--------------------------------|---|
| SITE_NAME | [none] |
| SUB_SITE | [none] |
| DATE_OBS | [DD-MON-YY] |
| TIME_OBS | [HHMM GMT] |
| MEAN_ABOVE_CANOPY_TEMP_10M | [degrees Celsius] |
| SDEV_ABOVE_CANOPY_TEMP_10M | [degrees Celsius] |
| MEAN_WITHIN_CANOPY_TEMP_2M | [degrees Celsius] |
| SDEV_WITHIN_CANOPY_TEMP_2M | [degrees Celsius] |
| MEAN_SURF_PRESS_15MIN | [kiloPascals] |
| SDEV_SURF_PRESS_15MIN | [kiloPascals] |
| MEAN_REL_HUM_15MIN | [percent] |
| SDEV_REL_HUM_15MIN | [percent] |
| MIXING_RATIO | [grams of water vapor][kilogram dry air ⁻¹] |
| MEAN_WIND_SPEED_15MIN | [meters][second ⁻¹] |
| SDEV_WIND_SPEED_15MIN | [meters][second ⁻¹] |
| MEAN_WIND_DIR_15MIN | [degrees true North in a clockwise direction] |
| SDEV_WIND_DIR_15MIN | [degrees true North in a clockwise direction] |
| U_COMPNT_WIND_VELOC | [meters][second ⁻¹] |
| V_COMPNT_WIND_VELOC | [meters][second ⁻¹] |
| RAINFALL_RATE_15MIN | [millimeters] |
| TOTAL_RAINFALL_RATE_15MIN | [millimeters] |
| ACCUM_PRECIP | [millimeters] |
| SNOW_DEPTH | [millimeters] |
| MEAN_INCIDENT_SHORTWAVE_15MIN | [Watts][meter ⁻²] |
| SDEV_INCIDENT_SHORTWAVE_15MIN | [Watts][meter ⁻²][*5] |
| MEAN_TOTAL_DOWN_PAR_15MIN | [Watts][meter ⁻²] |
| MEAN_DOWN_PPFD_15MIN | [microEinsteins][meter ⁻²][second ⁻¹] |
| SDEV_TOTAL_DOWN_PAR_15MIN | [Watts][meter ⁻²][*5] |
| MEAN_REFLECTED_SHORTWAVE_15MIN | [Watts][meter ⁻²] |
| SDEV_REFLECTED_SHORTWAVE_15MIN | [Watts][meter ⁻²][*5] |
| MEAN_NET_RAD_15MIN | [Watts][meter ⁻²] |
| SDEV_NET_RAD_15MIN | [Watts][meter ⁻²][*5] |
| MEAN_IR_TEMP_15MIN | [degrees Celsius] |
| SDEV_IR_TEMP_15MIN | [degrees Celsius] |
| COLD_PROBE_TEMP | [degrees Celsius] |
| WARM_PROBE_TEMP | [degrees Celsius] |
| MEAN_SOIL_TEMP_10CM_15MIN | [degrees Celsius] |
| SDEV_SOIL_TEMP_10CM_15MIN | [degrees Celsius] |
| MEAN_SOIL_TEMP_20CM_15MIN | [degrees Celsius] |
| SDEV_SOIL_TEMP_20CM_15MIN | [degrees Celsius] |
| MEAN_SOIL_TEMP_50CM_15MIN | [degrees Celsius] |
| SDEV_SOIL_TEMP_50CM_15MIN | [degrees Celsius] |
| CRTFCN_CODE | [none] |
| REVISION_DATE | [DD-MON-YY] |

| Suite B Column Name | Units |
|-----------------------------|-------------------------------------|
| SITE_NAME | [none] |
| SUB_SITE | [none] |
| DATE_OBS | [DD-MON-YY] |
| TIME_OBS | [HHMM GMT] |
| MEAN_DIFFUSE_DOWN_SHORTWAVE | [Watts] [meter ⁻²] |
| SDEV_DIFFUSE_DOWN_SHORTWAVE | [Watts] [meter ⁻²] [*5] |
| MEAN_DOWN_LONGWAVE | [Watts] [meter ⁻²] |
| SDEV_DOWN_LONGWAVE | [Watts] [meter ⁻²] [*5] |
| MEAN_THERMOPILE_VOLT | [millivolts] |
| SDEV_THERMOPILE_VOLT | [millivolts] |
| MEAN_RADIOMETER_CASE_TEMP | [degrees Celsius] |
| SDEV_RADIOMETER_CASE_TEMP | [degrees Celsius] |
| MEAN_RADIOMETER_DOME_TEMP | [degrees Celsius] |
| SDEV_RADIOMETER_DOME_TEMP | [degrees Celsius] |
| REVISION_DATE | [DD-MON-YY] |
| CRTFCN_CODE | [none] |

7.3.4 Data Source

| Suite A Column Name | Data Source |
|----------------------------|---|
| SITE_NAME | [Assigned by BORIS Staff] |
| SUB_SITE | [Assigned by BORIS Staff] |
| DATE_OBS | [CS Data Logger] |
| TIME_OBS | [CS Data Logger] |
| MEAN_ABOVE_CANOPY_TEMP_10M | [Calculated by the CS Data logger from the HMP35CF probe readings] |
| SDEV_ABOVE_CANOPY_TEMP_10M | [Calculated by the CS Data logger from the HMP35CF probe readings] |
| MEAN_WITHIN_CANOPY_TEMP_2M | [Calculated by the CS Data logger from the 107F temperature probe readings] |
| SDEV_WITHIN_CANOPY_TEMP_2M | [Calculated by the CS Data logger from the 107F temperature probe readings] |
| MEAN_SURF_PRESS_15MIN | [Calculated by the CS Data logger from] |
| SDEV_SURF_PRESS_15MIN | [Calculated by the CS Data logger from] |
| MEAN_REL_HUM_15MIN | Calculated by the CS Data logger from the HMP35CF probe readings] |
| SDEV_REL_HUM_15MIN | [Calculated by the CS Data logger from the HMP35CF probe readings] |
| MIXING_RATIO | [Derived using the fifteen-minute mean of the above canopy temperature, surface pressure, and relative humidity.] |
| MEAN_WIND_SPEED_15MIN | [Calculated by the CS Data logger from wind monitor instrument readings] |
| SDEV_WIND_SPEED_15MIN | [Calculated by the CS Data logger from wind monitor instrument readings] |
| MEAN_WIND_DIR_15MIN | [Calculated by the CS Data logger from wind monitor instrument readings] |
| SDEV_WIND_DIR_15MIN | [Calculated by the CS Data logger from wind monitor instrument readings] |
| U_COMPNT_WIND_VELOC | [Calculated by the CS Data logger from wind |

| | |
|--------------------------------|---|
| V_COMPNT_WIND_VELOC | monitor instrument readings] [Calculated by the CS Data logger from wind monitor instrument readings] |
| RAINFALL_RATE_15MIN | [Calculated by the CS Data logger from tipping bucket instrument readings] |
| TOTAL_RAINFALL_RATE_15MIN | [Calculated as a running sum of the RAINFALL_RATE_15MIN values] |
| ACCUM_PRECIP | [Calculated by the CS Data logger from Belfort rain gauge readings] |
| SNOW_DEPTH | [Calculated by the CS Data logger from the Ultrasonic depth gauge measurements] |
| MEAN_INCIDENT_SHORTWAVE_15MIN | [Calculated by the CS Data logger from the albedometer readings] |
| SDEV_INCIDENT_SHORTWAVE_15MIN | [Calculated by the CS Data logger from the albedometer readings] [See Section 9.1.1 for information] |
| MEAN_TOTAL_DOWN_PAR_15MIN | [Calculated by the CS Data logger from the PAR sensor readings] |
| MEAN_DOWN_PPFD_15MIN | [Calculated from the MEAN_TOTAL_DOWN_PAR_15MIN using the factor $4.54 \text{ microEinsteins sec}^{-1} \text{ Watts}^{-1}$ as given in McCartney, 1978.] |
| SDEV_TOTAL_DOWN_PAR_15MIN | [Calculated by the CS Data logger from the PAR sensor readings] [See Section 9.1.1 for information] |
| MEAN_REFLECTED_SHORTWAVE_15MIN | [Calculated by the CS Data logger from the albedometer readings] |
| SDEV_REFLECTED_SHORTWAVE_15MIN | [Calculated by the CS Data logger from the albedometer readings] [See Section 9.1.1 for information] |
| MEAN_NET_RAD_15MIN | [Calculated by the CS Data logger from the net radiometer readings] |
| SDEV_NET_RAD_15MIN | [Calculated by the CS Data logger from the net radiometer readings] [See Section 9.1.1 for information] |
| MEAN_IR_TEMP_15MIN | [Calculated by the CS Data logger from the IR thermometer readings] |
| SDEV_IR_TEMP_15MIN | [Calculated by the CS Data logger from the IR thermometer readings] |
| COLD_PROBE_TEMP | [Calculated by the CS Data logger from the unheated probe temperatures] |
| WARM_PROBE_TEMP | [Calculated by the CS Data logger from the heated probe temperatures] |
| MEAN_SOIL_TEMP_10CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |
| SDEV_SOIL_TEMP_10CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |
| MEAN_SOIL_TEMP_20CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |
| SDEV_SOIL_TEMP_20CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |
| MEAN_SOIL_TEMP_50CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |
| SDEV_SOIL_TEMP_50CM_15MIN | [Calculated by the CS Data logger from the soil temperature probe measurements] |

| | |
|---------------|---------------------------|
| CRTFCN_CODE | [Assigned by BORIS staff] |
| REVISION_DATE | [Assigned by BORIS staff] |

| Suite B Column Name | Data Source |
|-----------------------------|---|
| SITE_NAME | [Assigned by BORIS Staff] |
| SUB_SITE | [Assigned by BORIS Staff] |
| DATE_OBS | [CS Data Logger] |
| TIME_OBS | [CS Data Logger] |
| MEAN_DIFFUSE_DOWN_SHORTWAVE | [Calculated by the CS Data logger from pyranometer measurements] |
| SDEV_DIFFUSE_DOWN_SHORTWAVE | [Calculated by the CS Data logger from pyranometer measurements] [See Section 9.1.1 for information] |
| MEAN_DOWN_LONGWAVE | [Calculated by the CS Data logger from the pyrgeometer measurements. The information that BORIS personnel were able to obtain indicates that a dome heating correction was applied in the calculation of these values. See Smith, Crosson, and Tanner, 1992 and Eppley documentation for details on this correction.] |
| SDEV_DOWN_LONGWAVE | [Calculated by the CS Data logger from pyrgeometer measurements] [See Section 9.1.1 for information] |
| MEAN_THERMOPILE_VOLT | [Calculated by the CS Data logger from thermopile voltage measurements] |
| SDEV_THERMOPILE_VOLT | [Calculated by the CS Data logger from thermopile voltage measurements] |
| MEAN_RADIOMETER_CASE_TEMP | [Calculated by the CS Data logger from radiometer case temperature measurements] |
| SDEV_RADIOMETER_CASE_TEMP | [Calculated by the CS Data logger from radiometer case temperature measurements] |
| MEAN_RADIOMETER_DOME_TEMP | [Calculated by the CS Data logger from radiometer dome temperature measurements] |
| SDEV_RADIOMETER_DOME_TEMP | [Calculated by the CS Data logger from radiometer dome temperature measurements] |
| REVISION_DATE | [Assigned by BORIS staff] |
| CRTFCN_CODE | [Assigned by BORIS staff] |

7.3.5 Data Range

The actual ranges for the various parameters were not determined due to the large amount of data in this data set.

7.4 Sample Data Record

The following are wrapped versions of the first few data records contained in one of the Suite A and B data files on the BOREAS CD-ROMs:

SRC_Suite_A

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,MEAN_ABOVE_CANOPY_TEMP_10M,
SDEV_ABOVE_CANOPY_TEMP_10M,MEAN_WITHIN_CANOPY_TEMP_2M,
SDEV_WITHIN_CANOPY_TEMP_2M,MEAN_SURF_PRESS_15MIN,SDEV_SURF_PRESS_15MIN,
MEAN_REL_HUM_15MIN,SDEV_REL_HUM_15MIN,MIXING_RATIO,MEAN_WIND_SPEED_15MIN,
SDEV_WIND_SPEED_15MIN,MEAN_WIND_DIR_15MIN,SDEV_WIND_DIR_15MIN,
U_COMPNT_WIND_VELOC,V_COMPNT_WIND_VELOC,RAINFALL_RATE_15MIN,
TOTAL_RAINFALL_RATE_15MIN,ACCUM_PRECIP,SNOW_DEPTH,MEAN_INCIDENT_SHORTWAVE_15MIN,
SDEV_INCIDENT_SHORTWAVE_15MIN,MEAN_TOTAL_DOWN_PAR_15MIN,MEAN_DOWN_PPFD_15MIN,
SDEV_TOTAL_DOWN_PAR_15MIN,MEAN_REFLECTED_SHORTWAVE_15MIN,
SDEV_REFLECTED_SHORTWAVE_15MIN,MEAN_NET_RAD_15MIN,SDEV_NET_RAD_15MIN,
MEAN_IR_TEMP_15MIN,SDEV_IR_TEMP_15MIN,COLD_PROBE_TEMP,WARM_PROBE_TEMP,
MEAN_SOIL_TEMP_10CM_15MIN,SDEV_SOIL_TEMP_10CM_15MIN,MEAN_SOIL_TEMP_20CM_15MIN,
SDEV_SOIL_TEMP_20CM_15MIN,MEAN_SOIL_TEMP_50CM_15MIN,SDEV_SOIL_TEMP_50CM_15MIN,
CRTFCN_CODE,REVISION_DATE
'SSA-90A-FLXTR','AFM07-SRCA1',01-FEB-96,0,-31.5,.069,-30.4,.076,94.68,.007,47.9,
.414,.139,2.6,1.017,344.6,23.88,.6894,-2.5028,-999.0,-999.0,116.2,-999.0,1.192,
9.0,.514,2.334,1.0,.418,2.0,-45.588,26.0,-33.1,.179,1.266,4.274,-1.74,.005,-1.22,
.005,-.17,.005,'CPI',26-MAR-96
'SSA-90A-FLXTR','AFM07-SRCA1',01-FEB-96,15,-31.8,.182,-30.7,.083,94.69,.005,49.6,
.479,.14,1.8,.862,340.6,27.56,.5886,-1.6714,-999.0,-999.0,116.2,-999.0,-.698,0.0,
.071,.322,0.0,-.002,0.0,-41.142,10.0,-33.3,.135,1.266,4.274,-1.75,.005,-1.22,
.005,-.17,.005,'CPI',10-MAY-96
```

SRC_Suite_B

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,MEAN_DIFFUSE_DOWN_SHORTWAVE,
SDEV_DIFFUSE_DOWN_SHORTWAVE,MEAN_DOWN_LONGWAVE,SDEV_DOWN_LONGWAVE,
MEAN_THERMOPILE_VOLT,SDEV_THERMOPILE_VOLT,MEAN_RADIOMETER_CASE_TEMP,
SDEV_RADIOMETER_CASE_TEMP,MEAN_RADIOMETER_DOME_TEMP,SDEV_RADIOMETER_DOME_TEMP,
REVISION_DATE,CRTFCN_CODE
'SSA-90A-FLXTR','AFM07-SRCB1',01-FEB-96,0,5.714,.016,141.367,.021,-.041,.013,
-30.66,.162,-30.7,.159,26-MAR-96,'CPI'
'SSA-90A-FLXTR','AFM07-SRCB1',01-FEB-96,15,.289,.001,140.444,.039,-.041,.026,
-31.08,.108,-31.11,.075,10-MAY-96,'CPI'
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by BORIS was the data collected at a given site on a given day.

8.2 Data Format

The Compact Disk-Read-Only Memory (CD-ROM) files contain ASCII numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

9.1.1 Derivation Techniques and Algorithms

The data underwent some manipulation before they were sent to BORIS. These manipulations include such things as unit changes, and putting in -999 where there was missing data. The following formulas were used in calculating the variables sent to BORIS. ("aa" is equal to the value from the data logger; also see following note on value adjustments)

- Par Radiation: $(aa/900*1000)$.
- Par Radiation Standard Deviation: $(aa*1000)$.
- Net Radiation: $(aa/900*1000)$.
- Net Radiation Standard Deviation: $(aa*1000)$.
- Solar Down Radiation: $(aa/900*1000)$.
- Solar Down Radiation Standard Deviation $(aa*1000)$.
- Solar Reflected Radiation: $(aa/900*1000)$.
- Wind U Component: $(aa*(\sin((ab+180)*3.1459/180)))$ (where aa is Wind Speed and ab is Wind Direction).
- Wind V Component: $(aa*(\cos((ab+180)*3.1459/180)))$ (where aa is Wind Speed and ab is Wind Direction).
- Belfort Precipitation: aa minus initial base reading.
- Snow Depth: Height of snow depth sensor minus aa.

In Dec 1998, Alan Betts discovered that the standard deviations of all radiation values as given (for PAR, Solar, Net, Diffuse, and LW) are 5 times greater than they should be. This error arose because the values were accumulated in KJ/m² by the data logger for 5-sec intervals, and the standard Campbell Scientific formula was then used to calculate standard deviation from $N = 180$ accumulated values, X_i , in a 15-min interval (900 secs).

The 15-min mean in W/m² is given by:

$$X_{\text{mean}} = (1000/5) * 3X_i/N = (1000/900) * 3X_i$$

The calculation of the mean was done in post-processing by multiplying the accumulated flux by (1000/900).

The 15-min standard deviation in W/m² of the 180 5-sec samples is given by:

$$S = (1000/5) * [(3X_i^2 - (3X_i)^2/N)/N]$$

In this case the data logger software was used to compute the term in square brackets from the 5-sec values (units KJ/m²). The conversion to W/m² is again (1000/5), but the data logger value was only multiplied by 1000 in post-processing. Consequently the archived values for the standard deviation of the radiation fluxes must all be divided by a factor of 5.

The data loggers accumulated flux in KJ/m² for 5 sec intervals, and the conversion to W/m² is $aa*(1000/5)$, not the conversion of $aa*1000$, listed below, which was actually used in the original data processing.

Appendix Note

**** 82 Standard Deviation in Time**** formula taken from the Campbell Datalogger:

Function:

Calculate the standard deviation (STD DEV) of a given input location. The standard deviation is calculated using the formula:

$$S = ((3X_i^2 - (3X_i)^2/N)/N)$$

where X_i is the i th measurement and N is the number of samples.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

In completing data set publication efforts in August 1999, Dr. Alan Betts (Atmospheric Research) informed BORIS staff of a problem with the data provided for the Thompson Airport, Suite-A station (labeled in the final data as NSA-9BS-YTHSA) from December 24, 1994 to December 1, 1996. The problem was that the sign of the V-component of the wind direction was reversed from what it should have been. This resulted in the overall wind direction values being incorrect. BORIS staff worked with Dr. Betts to correct the two data values in each record and update the documentation as needed. Using the column names shown in section 7.3, the corrections (shown in the C programming language) were applied as follows:

```
V_COMPNT_WIND_VELOC = -V_COMPNT_WIND_VELOC;
if (MEAN_WIND_SPEED_15MIN != -999) /* The wind speed value is not undefined */
{
    if (V_COMPNT_WIND_VELOC == 0)
    {
        if (U_COMPNT_WIND_VELOC == 0) /* Both components are 0 */
        {
            MEAN_WIND_DIR_15MIN = 0;
        }
        else if (U_COMPNT_WIND_VELOC > 0)
        {
            MEAN_WIND_DIR_15MIN = 270;
        }
        else if (U_COMPNT_WIND_VELOC < 0)
        {
            MEAN_WIND_DIR_15MIN = 90;
        }
    }
    else if (V_COMPNT_WIND_VELOC > 0)
    {
        MEAN_WIND_DIR_15MIN = 180 +
            (180/pi)*atan(U_COMPNT_WIND_VELOC/V_COMPNT_WIND_VELOC);
    }
    else if (V_COMPNT_WIND_VELOC < 0)
    {
        MEAN_WIND_DIR_15MIN = 360 +
            (180/pi)*atan(U_COMPNT_WIND_VELOC/V_COMPNT_WIND_VELOC);
    }
    if (MEAN_WIND_DIR_15MIN > 360)
    {
        MEAN_WIND_DIR_15MIN = MEAN_WIND_DIR_15MIN - 360;
    }
}
```

9.3 Calculations

9.3.1 Special Corrections/Adjustments

See Sections 9.2.2 and 14.

9.3.2 Calculated Variables

See Sections 9.2.2 and 14.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

See Sections 4 and 9.1.1.

10.2 Quality Assessment

10.2.1 Data Validation by Source

The observers filled out a checklist each time the site was visited. Appendix A (at the end of this document) is a sample of the checklist the observers used to record needed information.

The AMS data are subjected to several levels of quality assurance. First there is a program (limit checker) that analyzes the data as they are downloaded every 6 hours. The limit checker spots any anomalies that may have occurred in the data in the previous 6-hour time period. The limit checker is a program written in C++. Each instrument has a C++ subroutine file that has the limits defined for that instrument. The printout of each error detected gives time of error, the instrument, and the number of occurrences of the error. The limits used for each parameter were:

- PAR Radiation - Upper 400; Noon 20; Lower -20
- Humidity - Upper 100; Lower 10
- Net Radiation - Upper 700; Midnight 0; Lower -100
- Pressure - Upper 105; Lower 90
- Upper Albedometer - Upper 900; Noon 50; Lower -20
- IR Temperature - Upper 50; Difference 10; Lower -45
- Lower Albedometer -Upper 500; Noon 2; Lower -20
- Wind Speed -Upper 23; Lower 0
- Upper Canopy Temperature - Upper 40; Difference 7; Lower -45
- Wind Direction - Difference 0
- Lower Canopy Temperature - Upper 40; Difference 7; Lower -45
- Belfort - Upper 300; Difference -3.5; Lower 0
- Soil Temperature 10 cm - Upper 30; Difference 10; Lower -20
- Snow Depth - Upper 3000; Lower 400
- Soil Temperature 20 cm - Upper 30; Difference 10; Lower -20
- Soil Moisture - Upper 30; Lower -20
- Soil Temperature 50 cm - Upper 30; Difference 10; Lower -20
- Tipping Bucket - min 2
- Humidity - min 98
- Tipping - min 1
- Battery -Lower 11.5

The data are screened once per month by plotting the data to examine them on a day-to-day basis, looking for any peculiar diurnal effects. The third stage is converting the data into the units requested by BORIS.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

BORIS personnel have reviewed portions of the actual parameter values and generated plots for use in visually spotting any anomalous values. In addition, BORIS staff applied the correction described in Section 9.2.2 to the wind direction values.

11. Notes

11.1 Limitations of the Data

Specific limitations of the data due to poor quality are given in Section 11.2.

11.2 Known Problems with the Data

This section lists the times when data are unavailable or there is a known difficulty with the data. The information is organized by measurement type (Suite A or Suite B), chronologically, and then by site.

Suite A: December 15, 1993 to January 15, 1994

All Sites

Regular site maintenance was not performed during the reporting period. Consequently heavy frost buildup occurred on all radiation instruments which may affect the accuracy of the data. Due to instrumentation design changes the Infrared sensor was not available for the reporting period. Prior to February 18, 1994, the pressure data at all BOREAS AFM-7 sites were offset by approximately -1.0 to -1.5 kPa. This means that the pressure values prior to February 18, 1994 can only be used to view trends, but the numbers themselves are not accurate and should not be used. The Saskatoon site was not corrected until April 14, 1994.

La Ronge

Snow depth data is relative to December 15, 1993. Belfort precipitation data is relative to December 15, 1993.

SSA-OA

Suite A data unavailable from December 24 to December 31, 1993. Belfort Precipitation Gauge not calibrated. Belfort Precipitation is relative to December 15, 1993. Snow Depth data unavailable. Sensor knocked over by an animal and damaged. Data available for part of January 10 & 11, 1994 due to a power supply shortage at site.

SSA-OJP

Snow depth data is relative to December 15, 1993. Belfort precipitation data is relative to December 15, 1993.

Lynn Lake

Snow depth data is relative to December 15, 1993. Belfort precipitation data is relative to December 15, 1993.

The Pas

Snow depth data is relative to December 15, 1993. Belfort precipitation data is relative to December 15, 1993. PAR Sensor is unavailable from December 22, 1993 to January 15, 1994 due to electronic malfunction.

Thompson

Snow depth data is relative to December 15, 1993. Belfort precipitation data is relative to December 15, 1993. No Pressure measurement available due to malfunction of instrument from December 15, 1993 to January 8, 1994. Data unavailable from January 8 to January 15, 1994.

Flin Flon

Snow depth data is relative to December 22, 1993. Belfort precipitation data is relative to December 22, 1993. Data unavailable from December 15 to December 22, 1993 due to power supply shortage. Partial data for December 24, 1993.

Suite A: January 15 to February 19, 1994**All sites**

IR Sensor data unavailable for Dec. 15 to Feb. 19, 1994. Soil moisture instrument out of season therefore no data available. Tipping bucket instrument out of season therefore no data available.

La Ronge

Regular site maintenance began on January 27, 1994.

Meadow Lake

Installation date February 3, 1994. Data for February 3 to February 19, 1994 only. No IR Sensor or Lower Canopy temperature at this site as there is no forest canopy. Soil temperatures to be installed when ground thaws. Regular site maintenance began on March 9, 1994.

SSA-OA

Data unavailable from January 15 to January 20, 1994. Snow depth sensor unavailable due to wildlife damage. Regular site maintenance began on February 22, 1994. Suite B THemisph data missing January 20 to March 29, 1994.

SSA-OJP

Regular site maintenance began on February 18, 1994.

Saskatoon

Data unavailable from January 15 to February 15, 1994. Installation date - February 15, 1994. Belfort precipitation data relative to February 15, 1994. Regular site maintenance began on February 24, 1994.

Lynn Lake

Regular site maintenance began on January 28, 1994.

The Pas

PAR Sensor unavailable from January 15 to January 30, 1994 due to instrument problems. Regular site maintenance began on January 29, 1994.

NSA-OJP

Belfort Precipitation sensor unavailable. Regular site maintenance began on January 28, 1994.

Thompson

Belfort Precipitation reset to zero on January 16, 1994. Regular site maintenance began on January 28, 1994.

Flin Flon

Regular site maintenance began on January 29, 1994.

Suite A: February 19 to March 31, 1994**La Ronge**

IR Sensor installed March 26, 1994 (85:2130). Special site maintenance March 26, 1994 -- tower lowered. March 2 to March 10 once an hour all values are missing due to program error.

Meadow Lake

No Belfort Precipitation available due to installation problems. Soil temperatures to be installed when ground thaws. March 2 to March 10 once an hour all values are missing due to program error.

SSA-OA

Data missing from March 17 (76:0600) to March 23 (82:2200), 1994 due to electronic failure of the data logger. Snow Depth data not available until February 22, 1994 (53:2000). March 2 to March 10 once an hour all values missing due to program error. Special site maintenance done on March 29, 1994 -- tower lowered.

SSA-OJP

March 2 to March 10 once an hour all values are missing due to program error. Special site maintenance done on March 31, 1994 -- tower lowered.

Saskatoon

Pressure data not available from February 19 to March 3, 1994 and from March 21 to March 28, 1994. Net radiation data not available from March 21 to March 31, 1994. Suite B data (ThPile, TCase and THemisph) missing February 19 to February 28, 1994. Suite B data (ThPile, TCase and THemisph) missing March 01 to April 03, 1994.

Lynn Lake

IR Sensor data not available until March 11, 1994 when it was installed. March 2 to March 10 once an hour all values are missing due to program error. Special site maintenance done on March 25, 1994 -- tower lowered.

The Pas

March 2 to March 10 once an hour all values are missing due to program error.

NSA-OJP

Belfort precipitation data not available until March 23, 1994 due to instrument problems. March 2 to March 10 once an hour all values are missing due to program error. Special site maintenance done on March 23, 1994 -- tower lowered.

Thompson

March 2 to March 10 once an hour all values are missing due to program error. Special site maintenance done on March 22, 1994 -- tower lowered.

Flin Flon

No IR sensor data available due to instrumentation design changes. March 2 to March 10 once an hour all values are missing due to program error.

Suite A: April 1 to April 30, 1994

La Ronge

Soil moisture temperature data commenced April 17, 1994.

Meadow Lake

Belfort precipitation data commenced April 18, 1994. Soil temperature data unavailable - not yet installed. Soil moisture data unavailable -- not yet installed.

SSA-OA

data missing from 91:2245 to 91:2315 due to program maintenance. Soil moisture data unavailable due to instrument malfunction.

SSA-OJP

Belfort data unavailable. Soil moisture data unavailable due to instrument malfunction.

Saskatoon

Net radiation data commenced April 5, 1994. Data missing part of April 1 and 2, 1994 (91:0215-92:0715). Soil moisture data unavailable -- instrument yet to be installed.

Lynn Lake

Soil moisture data unavailable -- instrument yet to be installed.

The Pas

Soil moisture data commenced April 17, 1994. Snow depth data unavailable from April 4 to April 8, 1994 and from April 14 to April 18, 1994.

NSA-OJP

Soil moisture data commenced April 17, 1994.

Thompson

Belfort precipitation data from April 11 to April 30, 1994 is unavailable.

Flin Flon

IR Temperature data commenced April 8, 1994. Soil moisture data unavailable -- not yet installed.

Suite A: May 1 to May 31, 1994

La Ronge

No data available from May 8 (128:1800) to May 11 (131:1915), 1994. Snow depth data not available for summer months. Tipping bucket data commences May 18, 1994. Soil moisture temperature commences May 18, 1994.

Meadow Lake

Soil Temperatures commenced May 21, 1994. Snow depth data not available for summer months. Belfort precipitation data is relative to April 18, 1994. No data available for May 26, 1994 (145:2200 to 146:2330)

SSA-OA

Snow depth data not available for summer months, 1994. Tipping bucket data commences May 1, 1994. Suite B ThPile data missing 147:2200, 1994.

SSA-OJP

Snow depth data not available for summer months, 1994. Tipping bucket data commences May 1, 1994. Suite B data missing 140:1530 to 140:1745, 1994.

Saskatoon

Pressure data not available from May 18 to May 27, 1994. Snow depth data not available for summer months, 1994. Suite B data missing 131:1430 to 133:0430. Suite B data missing 152:1915, 1994.

Lynn Lake

Snow depth data not available for summer months, 1994. Tipping bucket data commences May 15, 1994.

The Pas

Belfort precipitation data not available from May 17 to May 31, 1994. Snow depth data not available for summer months, 1994. Tipping bucket data commences May 15, 1994. Soil moisture temperature data commences May 25, 1994.

NSA-OJP

Belfort precipitation data not available from May 15 to May 31, 1994. Belfort precipitation is relative to March 23, 1994. Snow depth data not available for summer months, 1994. Tipping bucket data commences May 15, 1994. Soil moisture temperature data commences May 24, 1994.

Thompson

Belfort precipitation data not available from May 1 to May 31, 1994. Snow depth data not available for summer months, 1994. Tipping bucket data commences May 25, 1994. Soil moisture temperature data not available for all of 1994.

Flin Flon

Solar Reflected data not available from May 1 to May 31, 1994. Snow depth data not available for summer months, 1994. Tipping bucket data commences May 1, 1994. Soil moisture data commences May 30, 1994.

Suite A: June 1 to June 30, 1994**La Ronge**

Belfort precipitation is relative to December 15, 1993.

Meadow Lake

Belfort precipitation is relative to April 18, 1994. Tipping Bucket Data commences June 1, 1994. Soil moisture temperature data commences June 1, 1994.

SSA-OA

Data missing for part of June 14, 1994. Data missing from June 25 (176:0215) to June 30 (182:2400), 1994. Belfort precipitation is relative to December 15, 1993. Suite B data missing 152:1730 to 152:1845 and 175:0245 to 0300, 1994.

SSA-OJP

Belfort precipitation is relative to December 15, 1993. Soil moisture temperature data commences June 6, 1994.

Saskatoon

Belfort precipitation is relative to February 15, 1994. Tipping Bucket data commences June 2, 1994. Soil moisture temperature data commences June 1, 1994. Suite B data missing 165:1800.

Lynn Lake

Data missing from June 5 (156:1200) to June 14 (165:1800), 1994. Data missing from June 20 (171:1800) to June 24 (175:2245), 1994. Belfort precipitation is relative to December 15, 1993. Tipping bucket total reset to zero June 14, 1994. Tipping bucket total reset to zero June 24, 1994.

The Pas

Belfort precipitation data missing from June 1 to June 30, 1994. Data missing from June 23 (174:1800) to June 29 (180:2045), 1994. Tipping bucket total reset to zero June 29, 1994.

NSA-OJP

Belfort precipitation data missing from June 1 to June 14, 1994. Belfort precipitation is relative to June 14, 1994.

Thompson

Belfort precipitation data missing from June 1 to June 15, 1994. Belfort precipitation is relative to June 15, 1994.

Flin Flon

Belfort precipitation is relative to Dec. 15, 1993.

Suite A: July 1 to July 31, 1994**La Ronge**

Data missing from July 4 (185:1800) to July 8 (189:0600), 1994. Data missing from July 9 (190:0630) to July 11 (192:2330), 1994. Data missing from July 16 to July 31, 1994 with the exception of the radiation instruments (PAR, Net, SolarDown and Solar Reflected) for the period July 28 to July 31, 1994. Belfort precipitation not available from July 11 to July 31, 1994. Tipping Bucket total reset to zero on July 12, 1994.

SSA-OA

Data missing from July 10 (191:0015) to July 13 (194:2230), 1994. Data missing for part of July 1, 1994. Data missing for part of July 15, 1994. Data missing from July 16 (197:1815) to July 21 (202:0245), 1994. Data missing for part of July 22 (203:0015 to 1615), 1994. Belfort precipitation is relative to July 1, 1994. Tipping bucket total reset to zero July 2, 1994. Tipping bucket total reset to zero July 13, 1994. Tipping bucket total reset to zero July 15, 1994. Tipping bucket total reset to zero July 21, 1994. Tipping bucket total reset to zero July 23, 1994.

SSA-OJP

Data missing for July 15 (197:0000) to July 20 (201:2030), 1994. Tipping bucket total reset to zero July 20, 1994. Belfort precipitation data missing for July 15 to July 23, 1994. Belfort precipitation is relative to July 23, 1994. Suite B LW Down data missing June 28 to July 19, 1994.

Lynn Lake

Data missing for July 15 (197:0000) to July 18 (199:2000), 1994. Tipping bucket total reset to zero July 18, 1994.

The Pas

Belfort precipitation data missing for July 1 to July 31, 1994. Upper canopy temperature data missing from July 2 to July 10, 1994. Data missing for part of July 22, 1994. Belfort precipitation data relative to July 22, 1994.

Flin Flon

Belfort precipitation data missing for July 4 to July 21, 1994.

Suite A: August 1 to August 31, 1994

La Ronge

Data missing August 1 to August 11, 1994 except for the radiation sensors (PAR, Net, Solar Down and Solar Reflected).

SSA-OA

Data missing from August 6 to August 10, 1994. Tipping bucket total reset to zero August 11, 1994. Data missing from August 27 to August 30, 1994. Tipping bucket total reset to zero August 30, 1994. Belfort Precipitation reset to zero on August 12, 1994. Belfort Precipitation missing from August 6 to August 12, 1994. Belfort Precipitation missing from August 27 to August 31, 1994.

SSA-OJP

Data missing for part of August 19, 1994. Suite B data missing (ThPile, TCase, THemisph) for July 26 to Aug. 19, 1994.

Lynn Lake

Data missing from August 6 to August 16, 1994. Belfort Precipitation missing from August 15 to August 31, 1994. Tipping Bucket total reset to zero August 16, 1994.

The Pas

Note

the spikes in the Belfort precipitation data are due to an electronic malfunction of the instrument, however, the upper values of the graph are correct.

NSA-OJP

Belfort Precipitation missing from August 15 to August 31, 1994. Suite B data missing 2200:2215 to 293:1615 inclusive.

Suite A: September 1 to September 30, 1994

SSA-OA

Belfort Precipitation data missing from September 1 to September 30, 1994. Belfort Precipitation relative to September 30, 1994. Some instruments missing for part of September 1, 1994. SSA-OJP Some instruments missing for part of September 9, 1994. Suite B data missing (LW Down and ThPile) August 19 to October 02, 1994.

Lynn Lake

Belfort Precipitation data missing from September 1 to September 30, 1994. Data missing from September 26 to September 29, 1994. Tipping bucket total reset to zero September 29, 1994.

The Pas

Note

the spikes in the Belfort precipitation data are due to an electronic malfunction of the instrument, however, the upper values of the graph are correct.

NSA-OJP

Belfort Precipitation data missing from September 1 to September 30, 1994.

Flin Flon

Belfort Precipitation data missing from September 7 to September 30, 1994.

Suite A: October 1 to October 31, 1994

Meadow Lake

Tipping bucket data discontinued for winter months October 27, 1994.

SSA-OA

Belfort Precipitation data relative to October 1, 1994.

SSA-OJP

Suite B Data missing 289:1130 to 289:1315, 1994. Suite B data missing (LWDown and ThPile) for October 2 to November 11, 1994.

Saskatoon

Suite B data missing 301:2230 to 310:2245.

Lynn Lake

Belfort precipitation data missing for October 1, 1994. Belfort precipitation data missing for October 9 to October 31, 1994. Missing data for part of October 9, 1994. Missing data for October 16 to October 25, 1994. Tipping Bucket Total Reset to Zero on October 25, 1994.

The Pas

Note: the spikes in the Belfort precipitation data are due to an electronic malfunction of the instrument. The upper values of the graph, however, are correct.

NSA-OJP

Belfort precipitation data missing October 1 to October 31, 1994.

Thompson

Soil Moisture temperature data not available.

Flin Flon

Belfort precipitation relative to October 1, 1994. Tipping bucket data missing October 15 to October 25, 1994. Tipping bucket total reset to zero on October 25, 1994.

Suite A: November 1 to November 30, 1994

La Ronge

Belfort precipitation data missing from November 1 to November 21, 1994. Belfort precipitation relative to November 21, 1994.

Meadow Lake

Belfort precipitation data not available from November 1 to November 29, 1994. Belfort precipitation relative to November 29, 1994.

SSA-OA

November 2, 1994 at 2100 hours the Belfort precipitation gauge had unmelted snow bridging on it which was dumped in all at once by the observer and represents snowfall for that day. Snow depth data missing from November 9 to November 20, 1994. Suite B data missing (LW Down, ThPile, TCase, THemisph) 314:2030 to 314:2100, 1994.

SSA-OJP

Belfort precipitation data missing from November 1 to November 15, 1994. Belfort precipitation relative to November 15, 1994. Suite B data missing - LW Down 322:0015 to 331: 1645; ThPile 315:1945 to 322:0200; T Case and THemisph 322:0015 to 322:0145, 1994.

Lynn Lake

Belfort precipitation data missing from November 1 to November 3, 1994. Belfort precipitation data relative to November 3, 1994. Snow depth data missing from November 10 to November 30, 1994.

The Pas

Snow depth data missing from November 1 to November 30, 1994.

NSA-OJP

Belfort precipitation data missing from November 1 to November 20, 1994. Belfort precipitation relative to November 20, 1994. Snow depth data missing from November 19 to November 30, 1994.

Thompson

Belfort precipitation data missing from November 19 to November 21, 1994. Belfort precipitation relative to November 21, 1994.

Suite A: December 1 to December 31, 1994**La Ronge**

Belfort precipitation relative to November 21, 1994. Tipping Bucket data unavailable during winter months.

Meadow Lake

Belfort precipitation relative to November 29, 1994. Tipping Bucket data unavailable during winter months.

SSA-OA

Belfort precipitation relative to October 1, 1994. Tipping Bucket data unavailable during winter months.

SSA-OJP

Belfort precipitation relative to November 15, 1994. Tipping Bucket data unavailable during winter months. Suite B LW Down data missing 331:1700 to 339: 2300, 1994.

Saskatoon

Snow depth data missing from December 4 to December 13, 1994. Belfort precipitation relative to February 15, 1994. Tipping Bucket data unavailable during winter months.

Lynn Lake

Belfort precipitation data missing from December 1 to December 31, 1994. Snow depth data missing from December 1 to December 2, 1994. Snow depth data missing from December 5 to December 7, 1994. Tipping Bucket data unavailable during winter months.

The Pas

Belfort precipitation relative to December 8, 1994. Belfort precipitation data missing from December 1 to December 8, 1994. Tipping Bucket data unavailable during winter months.

NSA-OJP

Belfort precipitation relative to November 20, 1994. Tipping Bucket data unavailable during winter months. Suite B data missing 314:2215 to 342:0130 inclusive. Suite B data missing 341:1530 to 341:1830 inclusive.

Thompson

Wind speed and wind direction data missing from December 4 to December 24, 1994. Soil moisture temperatures missing December 1 to December 31, 1994. Tipping Bucket data unavailable during winter months.

Flin Flon

Belfort precipitation relative to October 1, 1994. Tipping Bucket data unavailable during winter months. Suite B data missing 339:1530 to 330:1600 and 342:1215.

Suite A: January 1 to January 31, 1995**La Ronge**

Snow depth sensor may be affected by a rabbit path located directly under sensor from January 1 to January 31, 1995.

SSA-OA

Belfort precipitation data missing from January 1 to January 27, 1995. Belfort precipitation relative to January 27, 1995.

Lynn Lake

Belfort precipitation data missing from January 1 to January 31, 1995.

Thompson

Soil moisture temperature data missing from January 1 to January 31, 1995.

Suite A: February 1 to February 28, 1995**SSA-OA**

duplicated time and day (34:15) -- the second one is correct.

Saskatoon

Belfort precipitation missing from February 3 to February 6, 1995. Belfort precipitation missing from February 8 to February 10, 1995.

Lynn Lake

Belfort precipitation missing from February 1 to February 12, 1995.

NSA-OJP

Data missing from February 2 to February 22, 1995. Snow depth data missing February 1 to February 22, 1995.

Thompson

Soil moisture temperature data missing from February 1 to February 28, 1995.

SuiteA: March 1 to March 31, 1995

Thompson

Soil moisture temperature data missing March 1 to March 31, 1995.

Suite A: April 1 to April 30, 1995

The Pas

Note: the spikes in the Belfort Precipitation data are due to electronic malfunction of the instrument, however the general shape of the graph is correct.

Thompson

Soil moisture temperature data missing April 1 to April 30, 1995.

Suite A: May 1 to May 31, 1995

La Ronge

Snow depth sensor removed May 12, 1995 for summer period. Tipping Bucket data restarted May 3, 1995.

Meadow Lake

Snow depth sensor removed May 1, 1995 for summer period. Tipping Bucket data restarted May 1, 1995.

SSA-OA

Snow depth sensor removed May 2, 1995 for summer period. Tipping Bucket data restarted May 1, 1995. Belfort precipitation missing May 22 to May 31, 1995.

SSA-OJP

Snow depth sensor removed May 2, 1995 for summer period. Tipping Bucket data restarted May 7, 1995.

Saskatoon

Snow depth sensor removed April 30, 1995 for summer period. Tipping Bucket data restarted May 1, 1995.

Lynn Lake

Snow depth sensor removed May 9, 1995 for summer period. Tipping Bucket data restarted May 15, 1995. Belfort precipitation missing May 15 to May 31, 1995.

The Pas

Snow depth sensor removed May 2, 1995 for summer period. Belfort precipitation missing May 7 to May 31, 1995. Note: the spikes in the Belfort Precipitation data are due to electronic malfunction of the instrument, however the general shape of the graph is correct.

NSA-OJP

Snow depth sensor removed May 6, 1995 for summer period. Belfort precipitation missing May 24 to May 31, 1995. Suite B missing data 126:1815 to 128:0330 inclusive. Suite B missing data 147:1815 to 149:0045 inclusive.

Thompson

Tipping Bucket data restarted May 8, 1995. Soil moisture temperature missing May 1 to May 31, 1995. Snow depth sensor removed May 16, 1995 for summer period.

Flin Flon

Tipping Bucket data restart May 1, 1995. Snow depth sensor removed May 10, 1995 for summer period.

Suite A: June 1 to June 30, 1995**La Ronge**

Data missing June 17 to June 23, 1995

SSA-OA

Belfort precipitation data missing June 1 to June 11, 1995. Belfort precipitation relative to June 11, 1995. Data missing part of June 17, 1995. Data missing part of June 20, 1995. Tipping Bucket relative to June 20, 1995. Suite B data missing 163:0030 to 163:0045, 1995. Suite B ThPile data missing 171:0515.

SSA-OJP

Data missing June 2 to June 22, 1995. Belfort precipitation relative to June 22, 1995. Tipping bucket precipitation relative to June 22, 1995. IR sensor data missing June 22 to June 30, 1995.

Lynn Lake

Belfort precipitation data missing June 1 to June 30, 1995. Data missing June 4 to June 15, 1995.

The Pas

Belfort precipitation data missing June 1 to June 30, 1995. Relative humidity data missing June 26 to June 30, 1995. Tipping bucket reset to zero June 21, 1995. Soil moisture temperature data missing from June 19-30, 1995.

NSA-OJP

Belfort precipitation data missing June 1 to June 24, 1995. Tipping bucket precipitation data missing June 1 to June 24, 1995. Belfort precipitation relative to June 24, 1995. Tipping bucket precipitation relative to June 24, 1995.

Thompson

Soil moisture temperature data missing June 1 to June 30, 1995.

Flin Flon

Belfort precipitation data missing June 28 to June 30, 1995. Suite B data missing 173:2200 to 173:2215 inclusive.

Suite A: July 1 to July 31, 1995**SSA-OA**

No data available for July 11, 1995 due to data logger malfunction. Tipping Bucket reset to zero on July 12, 1995.

SSA-OJP

IR sensor data not available from July 1-6, 1995 due to instrument malfunction.

Lynn Lake

No data available from July 6-15, 1995 due to data logger failure. Only partial data available from July 2-5, 1995 due to multiplexer failure. No data available from July 15-20, 1995 due to data logger failure. Belfort precipitation and tipping bucket reset to zero on July 20, 1995

The Pas

Belfort precipitation data not available from July 1-3, 1995 due to instrument malfunction. Humidity data not available from July 1-7, 1995 due to instrument malfunction. Upper canopy temperature not available from July 9-22, 1995 due to instrument malfunction. Soil moisture temperature data missing from July 1-31, 1995.

Thompson

Soil Moisture temperature data not available due to instrument malfunction.

Flin Flon

Belfort precipitation data not available from July 1-8, 1995 due to instrument malfunction. Belfort precipitation reset to zero on July 8, 1995.

Suite A: August 1 to August 21, 1995**La Ronge**

No data available from August 15-21, 1995 due to data logger failure. Belfort precipitation data reset to zero on August 29, 1995. Tipping bucket data reset to zero on August 21, 1995.

SSA-OA

No data available from August 8-10, 1995 due to data logger failure. Belfort precipitation data reset to zero on August 10, 1995. Tipping bucket data reset to zero on August 10, 1995. Some data not available on August 22 and August 27, 1995 due to repairs. Tipping bucket data reset to zero on August 23, 1995.

Saskatoon

20 cm soil temperature data not available from August 8-31, 1995 due to instrument malfunction.

Lynn Lake

No data available from August 2-14, 1995 due to data logger failure. Belfort precipitation data not available from August 2-15, 1995 due to instrument malfunction. Tipping bucket data reset to zero on August 15, 1995. Belfort precipitation data reset to zero on August 17, 1995.

The Pas

No data available from August 9-10, 1995 and August 13-16, 1995 due to data logger failure. Belfort precipitation data not available from August 1-31, 1995 due to instrument malfunction. Upper canopy temperature not available from August 15-25, 1995 due to instrument malfunction. Tipping bucket data reset to zero on August 16, 1996. Soil moisture temperature data missing from August 1-31, 1995.

NSA-OJP

Belfort precipitation not available August 1-15, 1995 not available. Belfort precipitation data reset to zero on August 17, 1995.

Thompson

Soil moisture temperature data not available August 1-31, 1995 due to instrument malfunction. No data available except radiation data (PAR_Rad, Net_Rad, Sol_down, Sol_refl) from August 17-31, 1995 due to multiplexer failure.

Suite A: September 1 to September 30, 1995

Meadow Lake

Tipping bucket data not available from September 1-30, 1995.

Saskatoon

20 cm soil temperature data not available from September 1-8, 1995 due to instrument malfunction.

Lynn Lake

No data available from September 12-24, 1995 due to data logger failure. Belfort precipitation data reset to zero on September 24, 1995. Tipping bucket data reset to zero on September 24, 1995.

The Pas

No data available from September 8-11, 1995 and part of September 15, 1995. Belfort precipitation data not available from September 1-30, 1995 due to instrument malfunction. Tipping bucket data reset to zero on September 11, 1995. Upper canopy temperature not available from September 15-30, 1995 due to instrument malfunction. Soil moisture temperature data missing from September 1-30, 1995.

Thompson

No data available except Radiation Data (PAR_Rad, Net_Rad, Sol_down, Sol_refl) from September 1-27, 1995 due to multiplexer failure. No data available from September 27-30, 1995 due to data logger failure.

Suite A: October 1 to October 31, 1995

Meadow Lake

Tipping bucket data not available from October 1-31, 1995.

Lynn Lake

Soil moisture temperature not available October 1-31, 1995 due to instrument malfunction.

The Pas

Soil moisture temperature data not available October 1-31, 1995 due to instrument malfunction. Belfort precipitation data not available from October 1-13, 1995 due to instrument malfunction. Belfort precipitation data reset to zero on October 14, 1995. Upper canopy temperature not available from October 1-14, 1995 due to instrument malfunction.

Thompson

No data available from October 1-13, 1995 due to data logger failure. Solar down and solar reflected radiation not available from October 13-31, 1995 due to instrument malfunction. Belfort precipitation and tipping bucket reset to zero on October 13, 1995.

Flin Flon

Tipping bucket data not available from October 15-31, 1995.

Suite A: November 1 to November 30, 1995

SSA-OJP

No data available from November 9-11, 1995 due to communication problems. Snow depth data not available from November 15-30, 1995 due to instrument malfunction.

Lynn Lake

Belfort precipitation data not available from November 1-19, 1995. Soil moisture temperature data not available from November 1-30, 1995 due to instrument malfunction. Belfort precipitation data reset to zero on November 19, 1995.

The Pas

Soil moisture temperatures not available November 1-30, 1995 due to instrument malfunction.

Thompson

Solar down and solar reflected radiation not available from November 1-23, 1995 due to instrument malfunction.

Suite A: December 1 to December 31, 1995**SSA-OJP**

Snow depth data not available from December 1-21, 1995 due to instrument malfunction.

Lynn Lake

Soil moisture temperatures not available from December 1-31, 1995 due to instrument malfunction.

The Pas

Soil moisture temperatures not available from December 1-31, 1995 due to instrument malfunction.

Flin Flon

No data available from Dec. 30-31, 1995 due to communication problems.

Suite A: January 1 to January 31, 1996**SSA-OA**

Snow depth data not available from January 15-31, 1996 due to instrument malfunction.

Lynn Lake

Soil moisture temperatures not available from January 1-31, 1996 due to instrument malfunction.

The Pas

Soil moisture temperatures not available from January 1 - 31, 1996 due to instrument malfunction.

NSA-OJP

Radiation sensors appear to have a buildup of snow/frost (Jan 1-31, 1996) because the observer may not be visiting this site regularly.

Thompson

Humidity data is affected by a malfunctioning sensor (Jan 1-31, 1996).

Suite A: February 1 to February 29, 1996**SSA-OA**

Snow depth data not available from February 1-9, 1996 due to instrument damage.

Lynn Lake

Soil moisture temperatures not available from February 1-29, 1996 due to instrument malfunction.

The Pas

Soil moisture temperatures not available from February 1-29, 1996 due to instrument malfunction.

Thompson

Humidity data is affected by a malfunctioning sensor (Feb. 1-15, 1996). Humidity data is not available from Feb. 15-29, 1996 due to instrument malfunction.

Suite A: March 1 to March 31, 1996**Lynn Lake**

Soil moisture temperatures not available from March 1-31, 1996 due to instrument malfunction.

The Pas

Soil moisture temperatures not available from March 1-31, 1996 due to instrument malfunction.

Suite A: April 1 to April 30, 1996**Lynn Lake**

Soil moisture temperatures not available from April 1-30, 1996 due to instrument malfunction.

The Pas

Soil moisture temperatures not available from April 1-30, 1996 due to instrument malfunction.

Suite A: May 1 to May 31, 1996**La Ronge**

No data available from May 9 to May 12, 1996 due to communication problems. Tipping bucket data commenced May 16, 1996. Snow depth data complete May 22, 1996.

Meadow Lake

Tipping bucket data commenced May 1, 1996. Snow depth data completed April 30, 1996.

SSA-OA

Tipping bucket data commenced May 1, 1996. Snow depth data complete May 15, 1996.

SSA-OJP

Tipping bucket data commenced May 12, 1996. Snow depth data complete May 29, 1996.

Saskatoon

Tipping bucket data commenced May 1, 1996. Snow depth data completed May 11, 1996.

Lynn Lake

Tipping bucket data commenced May 1, 1996. Soil moisture temperatures not available May 1 - May 31, 1996 due to instrument malfunction. Snow depth data completed May 24, 1996. No data available May 30-31, 1996 due to data logger malfunction.

The Pas

Snow depth data completed May 10, 1996. Soil Moisture temperatures not available due to instrument malfunction May 1 - May 31, 1996. Tipping bucket data commenced May 26, 1996.

NSA-OJP

Tipping bucket data commenced May 5, 1996. Snow depth data completed May 17, 1996.

Thompson

Snow depth data completed May 28, 1996.

Flin Flon

Tipping bucket data commenced May 1, 1996. Snow depth data completed May 17, 1996.

Suite A: June 1 to June 30, 1996**SSA-OA**

No data available from June 3 to 7, 1996.

Lynn Lake

Soil moisture temperatures repaired on June 5, 1996. No data available from June 1 to 5, 1996; June 7 to 13, 1996; June 19 to 24, 1996 and from June 29 to 30, 1996.

The Pas

Soil moisture temperatures repaired on June 4, 1996. No data available from June 19 to 30, 1996.

Suite A: July 1 to July 31, 1996**La Ronge**

No data available from July 14 to 15 and from July 24 to 30, 1996. Belfort Precipitation data not available for July 15 to 31, 1996. Tipping bucket data reset to zero on July 15, 1996. Tipping bucket data reset to zero on July 30, 1996.

SSA-OA

No data available from July 5 to 8, 1996 and part of July 11 to 12, 1996. No data available for part of July 21 to 22, July 30 to 31 and from July 24 to 28, 1996 due to data logger failure. Tipping bucket data reset to zero on July 8, July 12, July 21, 1996. Tipping bucket data not available from July 22 to 31, 1996. Belfort precipitation data reset to zero on July 28, 1996.

Lynn Lake

No data available from July 1 to 2, 1996 due to data logger failure. Tipping bucket data reset to zero on July 2, 1996.

The Pas

Tipping bucket data not available from July 1 to 31, 1996. Belfort precipitation data reset to zero on July 1, 1996.

Suite A: August 1 to August 31, 1996**La Ronge**

No data available from August 1 to 5 and from August 10 to 14, 1996 due to data logger failure. No Belfort precipitation data from August 14 to 25, 1996 due to instrument malfunction. Belfort precipitation data reset to zero on August 5, 1996. Tipping bucket data reset to zero on August 14, 1996.

SSA-OA

No data available from August 1 to 6, 1996 due to data logger failure. Tipping bucket data reset to zero on August 6, 1996.

Saskatoon

No data available from August 2 to 6, 1996 due to data logger failure. Tipping bucket data reset to zero on August 6, 1996.

Lynn Lake

No data available from August 4 to 12, and from August 21 to 23 due to data logger failure. Belfort precipitation data not available from August 1 to 31, 1996 due to instrument malfunction. Tipping bucket data reset to zero on August 12 and August 23, 1996.

The Pas

Tipping bucket data not available from August 1 to 31, 1996 due to instrument malfunction.

Suite A: September 1 to September 30, 1996**La Ronge**

Vandals placed an item into the Belfort Fluid on August 31, 1996 which was removed on September 2, 1996. Disregard the sudden addition and subtraction of the Belfort measurement.

Lynn Lake

Belfort precipitation data not available from September 1 to 30, 1996.

Suite A: October 1 to October 31, 1996**La Ronge**

Belfort precipitation not available from October 6 to 15 and from 19 to 31, 1996 due to vandalism at the site. Belfort precipitation data not available from October 19 to 31, 1996 due to vandalism at the site.

Lynn Lake

Belfort precipitation data not available from October 1 to 15, 1996. Belfort precipitation data reset to zero on October 17, 1996.

Suite A: November 1 to November 30, 1996**La Ronge**

Snow depth data not available November 1 to 30, 1996 due to vandalism at the site. Belfort precipitation data not available November 1 to 30, 1996 due to vandalism at the site.

Lynn Lake

No data available from November 22 to 30, 1996 due to instrument malfunction.

Thompson

Prior to September 1999, the wind direction data stored in BORIS were incorrect for the Thompson station (NSA-9BS-YTHSA) from 24-Dec-1994 to 01-Dec-1996. See Section 9.2.2 for details on the corrections applied.

Suite B

SSA-OA

- THemisph data not available Jan 20-March 29, 1994.
- Data missing from 314:2030 to 314:2199, 1995 due to site maintenance.
- Data missing 163:0030 to 163:0045, 1995 inclusive.
- ThPile data missing 171:0515, 1995.
- ThPile data missing 254:2345 to 255:0015, 1995 inclusive.
- LW Down, TCase and THemisph data missing 255:0000 to 255:0015, 1995 inclusive.
- Data missing 298:1045 to 321:2330, 1995 inclusive.
- LW Down, ThPile, TCase and THemisph data missing 325:2045 to 325:2100, 1995 inclusive.
- LW Down, ThPile, TCase and THemisph data missing 136:0145 to 136:0215, 1996 inclusive. LW Down, ThPile, TCase and THemisph data missing 168:0000 to 168:0015, 1996 inclusive.
- Data missing 199:1045 to 199:1345, 1996 inclusive.
- Data missing 230:2030 to 237:1745, 1996 inclusive.
- Data missing 237:1800 to 251:1730, 1996 inclusive.
- Data missing 253:0200, 1996.

SSA-OJP

- Data unavailable from July 19 to July 26/94.
- ThPile, TCase and THemisph unavailable from July 20-Oct 02, 1994 due to equipment failure.
- LW Down and ThPile data missing Oct. 2 - Nov. 11, 1994.
- LW Down data missing 322:0015 to 338:2245, 1994.
- ThPile data missing from 315:1945 to 322:0200, 1994.
- TCase and THemisph data missing from 322:0015 to 322:0145, 1994 due to equipment failure.
- Data missing 153:0000 to 173:1730, 1995 inclusive.
- Data missing 268:0900 to 275:1600, 1995 inclusive.
- Data missing 290:1800 to 290:1830, 1995 inclusive.
- Data missing 303:0500 to 303:0530, 1995 inclusive.
- LWDown data missing 326:0015 to 337:1730, 1995 inclusive.
- ThPile, TCase and THemisph data missing 326:0015 to 326:0030, 1995 inclusive.
- Data missing 355:1930 to 355:1445, 1995 inclusive.
- LW Down data missing 337:1745 to 355:2045, 1995 inclusive.
- LW Down, ThPile, TCase and THemisph data missing 155:1330 to 155:1345, 1996 inclusive.
- LW down, ThPile, TCase and THemisph data missing 298:2000-2045, 1996 inclusive.

Saskatoon

- Data missing from 301:2230 to 301:2245, 1994 due to equipment maintenance.
- LW Down data missing 250:0900 to 185:0115, 1995 inclusive.
- ThPile, TCase, THemisph data missing 285:0100 to 285:0115, 1995 inclusive.
- LW Down, ThPile, TCase and THemisph data missing 131:2215, 1996.
- Data missing 214:1400 to 219:1715, 1996 inclusive.

NSA-OJP

- Data missing from 220:2215 to 233:0400, 1994 due to observer error.
- Data missing 341:2215 to 342:0130, 1994 due to site maintenance.
- Data missing 126:1815 to 128:2130, 1995.
- Data missing 147:1215 to 148:1845, 1995.
- Data missing 327:1215 to 345:0400, 1995 inclusive.
- LW Down, ThPile, TCase and THemisph data missing 158:1500, 1996.

Flin Flon

- Data missing 339:1530 to 339:1600, 1994 inclusive.
- Data missing 342:1215, 1994 due to site maintenance.
- Data missing 173:2200 to 173:2215, 1995 inclusive.
- Data missing 326:1745, 1995. LW Down, ThPile, TCase and THemisph data missing 156:0245, 1996.
- Data missing 335:1630 to 336:0600 inclusive.

11.3 Usage Guidance

Guidance on proper usage should come from review of the information given in Sections 9.2.2 and 11.2.

11.4 Other Relevant Information

None.

12. Application of the Data Set

These data will be useful in many ways. The length of time over which regular measurements were made presents an unmatched opportunity to study the microclimate of the boreal forest. A succinct list is impossible to create because of the broad nature of studies to which these data are applicable. However, the following short list provides a general description of the types of studies that might find these data useful:

- Modeling of earth surface processes (climate, weather, vegetation growth, etc.)
- Validation of existing models
- Creation of new methods for estimating climate and meteorological parameters

13. Future Modifications and Plans

The data that were collected for the BOREAS project officially ended on 30-Nov-1996. There are a few sites, however, that were maintained for a longer period of time through non-BOREAS funding. These data are not available from the official BOREAS database, but information on how to obtain these supplemental data can be received by contacting the BOREAS staff.

14. Software

14.1 Software Description

Campbell Scientific data logger programs were developed for the various sites. Quality checking software was developed and used at the SRC office.

14.2 Software Access

A file containing the Campbell Scientific data logger programs for the various sites is available and included on the BOREAS CD-ROM. Contact SRC regarding the quality checking software that was developed and used at the SRC office.

15. Data Access

The surface meteorological and radiation data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornl daac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics
<http://www-eosdis.ornl.gov/>.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None.

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series. A report on analysis of the soil probe/soil moisture measurements is also available and is included on the BOREAS CD-ROM.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

BEI Motion Systems Company. ND. Specifications: Series M25 Absolute Position Encoders. BEI Motion Systems Company, Chatsworth, CA.

Belfort Instrument Company. 1985. Instruction Manual Rain Gage Catalog Numbers 35-1558 and 35-1559: Instructions - Maintenance - Parts List. Belfort Instrument Company, Baltimore, MD.

Belfort Instrument Company. 1987. Instruction Book for Rainfall Transmitter Cat. No. 5915 Series - Related Instruction Book Chart Drive Mechanism 12049. Belfort Instrument Company, Baltimore, MD.

Campbell Scientific (Canada) Corporation. 1985. Belfort Weighing Rain and Snow Gage Series 5915 and 6071P. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1987. Model TE525 Tipping Bucket Raingage. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1991. DC112 Modem. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1991. Precision Meteorological Instruments. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1991. Radiotelemetry Network Applications Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1991. TE525 Tipping Bucket Raingage. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1992. 036, 038 Spark Gapped Junction Box. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1992. FP/BCD Interface Instruction Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1992. RF95 Radio Frequency System. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1993. 05103-10, 05305-10 and 05701-10 R.M. Young Wind Monitors Instruction Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1993. 4000AL Everest Interscience Infrared Thermometer Instruction Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1993. Model 107F Temperature Probe Instruction Manual. Campbell Scientific (Canada) Corporation.

Campbell Scientific (Canada) Corporation. 1993. Model HMP35CF Temperature and Relative Humidity Probe Instruction Manual. Campbell Scientific (Canada) Corporation.

Campbell Scientific, Inc. 1993. PC208 Data Logger Support Software Instruction Manual. Campbell Scientific, Inc.

Campbell Scientific (Canada) Corporation. 1993. UDG01 Ultrasonic Depth Gauge Operator's Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1994. 4000AL Everest Interscience Infrared Thermometer Instruction Manual. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

Campbell Scientific (Canada) Corporation. 1994. Q-7 Net Radiometer. Campbell Scientific (Canada) Corporation, Edmonton, Alberta.

DSG Communications Inc. 1993. LineShare LS-2 User's Manual. DSG Communications Inc., Saskatoon, Saskatchewan.

E.F. Johnson Data Telemetry Products. ND. 3410 Series Telemetry Modules. E.F. Johnson Data Telemetry Products, Pickering, Ontario.

Environment Canada. 1992. Manual of Surface Weather Observations (MANOBS). Environment Canada, Downsview, Ontario.

The Eppley Laboratory, Inc. ND. Instrumentation for the Measurement of the Components of Solar and Terrestrial Radiation. The Eppley Laboratory, Inc., Newport, RI.

Meteorology Research, Inc. 1967. Tipping Bucket Raingage Model 302. Meteorology Research, Inc., Altadena, CA.

ROHN Towers. 1983. "Fold-over" Towers. ROHN, Peoria, IL.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. *Bulletin of the American Meteorological Society*. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. *Journal of Geophysical Research* 102(D24): 28,731-28,770.

Shewchuk, S.R. 1993. Atmospheric Sciences Infrastructure Core Measurements for BOREAS. Saskatchewan Research Council [SRC] Pub. No. E-2300-6-F-92, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1994. Atmospheric Science Infrastructure Measurements for BOREAS. Saskatchewan Research Council [SRC] Pub. No. E-2310-3-E-94, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1994. Atmospheric Sciences Surface MESONET Infrastructure Core Measurements for BOREAS. Saskatchewan Research Council [SRC] Pub. No. E-2300-7-F-94, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1995. The Surface Mesoscale Meteorological System for BOREAS/ Abstract. Saskatchewan Research Council [SRC] Pub. No. E-2310-1-D-95, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1996. An Overview of the Climatology for the Intensive Field Campaign Years of 1994 and 1995 at a Selected BOREAS/SRC Mesonet Site. Draft. Saskatchewan Research Council [SRC] Pub. No. R-1570-2-D-96, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1996. The Mesoscale Distribution of Soil Moisture over the SRC/NASA Mesonet Sites for the IFC 2 Periods of 1994. Draft. Saskatchewan Research Council [SRC] Pub. No. R-1570-1-D-96, SRC, Saskatoon, Saskatchewan.

Shewchuk, S.R. 1997. Surface Mesonet for BOREAS. *Journal of Geophysical Research* 102 (D24): 29,077-29,082.

Smith, E.A., W.L. Corsson, and B.D. Tanner, 1992. Estimation of surface heat and moisture fluxes over a prairie grassland 1. In situ energy budget measurements incorporating a cooled mirror dew point hygrometer. *Journal of Geophysical Research* 97 (D17): 18,557 - 18,582.

Wittrock, V. 1994. Examination of the Matrix Water Potential Sensor. Saskatchewan Research Council [SRC] Pub. No. E-2310-4-E-94, SRC, Saskatoon, Saskatchewan.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

| | |
|---------|--|
| AES | - Atmospheric and Environmental Services |
| AFM | - Aircraft Flux and Meteorology |
| AMS | - Automatic Meteorological Station |
| ASCII | - American Standard Code for Information Interchange |
| BOREAS | - BOREal Ecosystem-Atmosphere Study |
| BORIS | - BOREAS Information System |
| BPI | - Byte per inch |
| CCRS | - Canada Centre for Remote Sensing |
| CCT | - Computer Compatible Tape |
| CD-ROM | - Compact Disk-Read-Only Memory |
| DAAC | - Distributed Active Archive Center |
| DAT | - Digital Archive Tape |
| EOS | - Earth Observing System |
| EOSDIS | - EOS Data and Information System |
| FAX | - Facsimile |
| FIFE | - First ISLSCP Field Experiment |
| GIS | - Geographic Information System |
| GMT | - Greenwich Mean Time |
| GSFC | - Goddard Space Flight Center |
| HTML | - HyperText Markup Language |
| IFC | - Intensive Field Campaign |
| IR | - Infrared |
| ISLSCP | - International Satellite Land Surface Climatology Project |
| MARSII | - Meteorological Automatic Reporting System II |
| MESONET | - Mesoscale Network |
| NAD27 | - North American Datum of 1927 |
| NAD83 | - North American Datum of 1983 |
| NASA | - National Aeronautics and Space Administration |
| NSA | - Northern Study Area |
| ORNL | - Oak Ridge National Laboratory |
| PANP | - Prince Albert National Park |
| PAR | - Photosynthetically Active Radiation |
| READAC | - Remote Environmental Automated Data Acquisition Concept |
| SRC | - Saskatchewan Research Council |
| SSA | - Southern Study Area |
| URL | - Uniform Resource Locator |
| UTM | - Universal Transverse Mercator |

20. Document Information

20.1 Document Revision Date

Written: 15-Dec-1994

Last Update: 23-Sep-1999

20.2 Document Review Date

BORIS Review: 24-Feb-1998

Science Review: 06-Mar-1998

20.3 Document ID

20.4 Citation

When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

These data were provided by the diligent work of many people within Saskatchewan Research Council. Special thanks go to the observers for their assistance with this report.

If using data from the BOREAS CD-ROM series, also reference the data as:

Shewchuk S.R., "Atmospheric Sciences Infrastructure Core Measurements for BOREAS (AFM-07)." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

| REPORT DOCUMENTATION PAGE | | | Form Approved OMB No. 0704-0188 | |
|--|---|--|--------------------------------------|--|
| Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503. | | | | |
| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE June 2000 | 3. REPORT TYPE AND DATES COVERED Technical Memorandum | | |
| 4. TITLE AND SUBTITLE Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS) BOREAS AFM-07 SRC Surface Meteorological Data | | 5. FUNDING NUMBERS 923 RTOP: 923-462-33-01 | | |
| 6. AUTHOR(S) Heather Osborne, Kim Young, Virginia Wittrock, and Stan Shewchuck Forrest G. Hall and Jeffrey A. Newcomer, Editors | | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES) Goddard Space Flight Center Greenbelt, Maryland 20771 | | 8. PERFORMING ORGANIZATION REPORT NUMBER 2000-03136-0 | | |
| 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES) National Aeronautics and Space Administration Washington, DC 20546-0001 | | 10. SPONSORING / MONITORING AGENCY REPORT NUMBER TM—2000—209891 Vol. 15 | | |
| 11. SUPPLEMENTARY NOTES H. Osborne, K. Young, V. Wittrock, and S. Shewchuck: Saskatchewan Research Council; J.A. Newcomer: Raytheon ITSS | | | | |
| 12a. DISTRIBUTION / AVAILABILITY STATEMENT Unclassified—Unlimited Subject Category: 43 Report available from the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390. | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) The Saskatchewan Research Council (SRC) collected surface meteorological and radiation data from December 1993 until December 1996. The data set comprises Suite A (meteorological and energy balance measurements) and Suite B (diffuse solar and longwave measurements) components. Suite A measurements were taken at each of 10 sites, and Suite B measurements were made at 5 of the Suite A sites. The data cover an approximate area of 500 km (North-South) by 1,000 km (East-West) (a large portion of northern Manitoba and northern Saskatchewan). The measurement network was designed to provide researchers with a sufficient record of near-surface meteorological and radiation measurements. The data are provided in tabular ASCII files, and were collected by AFM-7. | | | | |
| 14. SUBJECT TERMS BOREAS, surface meteorological and radiation data. | | | 15. NUMBER OF PAGES 75 | |
| | | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT Unclassified | 18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified | 19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified | 20. LIMITATION OF ABSTRACT UL | |